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CONTENTS.

PAGE

ILLUSTRATED ARTICLES:
ELECTRICAL WORLD Portraits, VI.—Elmer A. Sperry..... 340
Electric Fountains at the Paris Exposition..... 341
The New Thomson-Houston Station, Salem, Mass..... 342
The Sperry System of Electric Lighting..... 343
The Sperry Electrical Coal Digger..... 345
A New Wheatstone Bridge Set..... 346
"Drop a Nickel in the Slot" Anticipated. By Prof. E. J. Houston..... 346
The Westinghouse Alternating Motor and Fan..... 346
The Inherent Defects of Lead Secondary Batteries. By Dr. L. Duncan and H. Wiegand..... 347
The Inherent Defects of Lead Storage Batteries..... 348
Marshall Adjustable Condensers..... 350

CORRESPONDENCE:
Ampère Feet and Ampère Turns. By "I. G."..... 342
Waterproof and Fireproof Motors. By J. H. Bickford..... 346
Charging Potential of Storage Batteries. By "Reader"..... 346
Mr. Harold P. Brown on Insulated Wires. By H. P. Brown..... 350
The Ideal Dynamo of the Future. By H. F. Watts..... 350

EDITORIAL:
Paragraphs..... 339

MISCELLANEOUS:
Magneto Morse Sounder..... 340
Recording Voltmeter..... 340
Cardew's Safety Device for Transformers..... 340
On the Concentration of Electric Radiation by Lenses..... 340
On the Influence of the Density of the Acidulated Water in an Accumulator. By Dr. L. Paget..... 341
The Edison Electric Light on Board the "Pouyer Quertier"..... 349
Mr. Wiman on the Telephone and Telegraph..... 349
Telegraphing the News of the Derby..... 349
Telephone Amalgamation in England..... 350
The Disaster at Johnstown, Pa..... 350
Resumption of Ticker Service..... 350
The Eiffel Tower and the Spectroscope..... 350
Electrical Opportunities in Southwestern Missouri..... 351

SPECIAL CORRESPONDENCE:
New York Notes, 351; New England Notes, 351; Philadelphia Notes, 352; Western Notes..... 352

DEPARTMENTS:
The Telegraph, 353; The Telephone, 353; The Electric Light, 353; Applications of Power, 353; Personals, 353; Miscellaneous Notes, 353; Business Notices..... 353
Our Illustrated Record of Electrical Patents..... 354

Electrical Executions. WE are glad to see that a reprieve has been granted in the case of the murderer condemned to be executed by electricity. There is now some hope that the criminal will get his deserts by ordinary and well-tested means, and that electricity may never be known as an agency of capital punishment.

An "Anticipated" Invention. A GREAT many electricians have of late been engaged on inventions for applying electrically the principles involved in the operation of "drop a nickel in the slot" devices. It has generally been supposed by them, as well as by everybody else, that these devices were among the triumphs of modern ingenuity for doing things by machinery, and they will have no little surprise on learning from Prof. E. J. Houston, whose article on the subject we publish this week, that the device, with mechanical operation, was in use at least two thousand years ago. There is some satisfaction, however, in knowing that in this case there is no electrical "anticipation."

Storage Batteries. THE paper read by Mr. A. S. Brown before the American Institute of Electrical Engineers, detailing the practical experience obtained with them in railroad service, was well supplemented by the results of an investigation on storage batteries presented by Dr. Louis Duncan and Mr. H. Wiegand. The paper brings out a number of interesting points on the nature of the losses which take place during the charge and discharge of a storage battery, and which, according to the authors, are the necessary accompaniments of a lead storage cell. They point out also very forcibly the result of uneven diffusion of the electrolyte in the plugs of active material, caused by their peculiar shape. The study of the temperature of the cell during charge and discharge also leads to some interesting conclusions.

The Eiffel Tower. WHEN the Eiffel Tower was first proposed its erection was encouraged on the ground that it would afford a valuable aid to scientific research, more especially the study of atmospheric electricity and meteorology in general. While it is yet too early to expect any results in this field of science, it is gratifying to learn that the tower has already been the means of calling forth a notable observation by the celebrated French astronomer, M. Janssen, who, by studying the powerful arc light at the top of the tower by means of the spectroscope has come to the conclusion that there is no oxygen contained in the sun. This sufficiently startling announcement may be expected to be followed by others from other unexpected quarters. It may be argued that the same results might have been obtained by studying other powerful arcs already in existence, but the bringing of such a structure within close proximity to a large number of scientists in various departments must necessarily lend it a value which it could not possess in any other situation. It is also worthy of note that the arc lights on the tower were found very useful last week in furthering some operations on the Seine, when, by request, a powerful beam was projected from the tower upon the locality where the work was going on.

City Rapid Transit. BOSTON appears to be, on the whole, very well satisfied with the outlook for rapid transit presented by the adoption of electricity on the West End roads, in spite of the fact that the service is to be given by means of overhead wires. The Boston experiment is an interesting one, and will, without doubt, be carried through successfully. But here in New York we have other conditions which may be improved but cannot be disregarded or abolished. In short, we have to consider the rapid transit problem with respect to the elevated roads, whose service with steam has been a great boon but remains very unsatisfactory. It is now asserted, and believed by many, that the substitution of electricity for steam will meet nearly all the existing difficulties; and the trials that have taken place on the elevated roads go to prove that electricity should be employed. It is these considerations which give unusual interest to the paper which is to be presented before the American Institute of Electrical Engineers next week by Mr. Leo Daft, on his work on the elevated roads. By this time Mr. Daft has made a great many runs on the Ninth avenue road and carried a great many passengers, and the valuable data he has obtained is of the first importance not only to electrical men, but to every civil and mechanical engineer in the country.

The Ideal Dynamo. A FEW years ago it was thought that dynamo building would soon reach a state of perfection beyond which it would be practically impossible to advance. So far as the efficiency of dynamo-electric machines is concerned, there is, indeed, very little room for improvement, but no one who studies attentively the drift of recent work will deny that changes are going on which, though not of such far reaching influence, as those which earlier in the art placed the dynamo in the forefront of the converters of energy, are nevertheless of importance, when we consider the dynamo as an operative, lasting piece of apparatus, designed to run continuously and to be capable of withstanding temporary abnormal conditions with safety. We remark these changes on contemplating the continued efforts to improve the details of construction of the machines, as a result of which such machinery may now be subjected even designedly to treatment which would have been certain destruction in machines of earlier construction, and in which the improved water-proof qualities of the new machines are shown to be of preëminent value. While not denying this, one of our old and esteemed correspondents, Mr. H. F. Watts, seems to think that the better direction in which to work is in the production of a fire-proof armature for such machines. His ideal armature is one which would contain no cotton at all, and only asbestos, mica, or porcelain would find a place as insulators. There is certainly nothing in the nature of things which would stand in the way of a construction embodying these elements. The cost would, of course, be higher than that of the present method. But whether the additional security obtained is sufficiently great to warrant the expense is a question which will have to be decided for himself by each individual constructor. It seems more than likely, however, that such a construction, once inaugurated, would not be long in becoming firmly established, as so many other desirable features have become in the past.

Electric Lighting in London. FOR several weeks past the various companies who had applied for licenses and powers to supply electricity in London have been given hearings on their proposed schemes before Major Marindin, the inspector appointed by the Board of Trade. The dozen or more companies applying intended to distribute current on pretty well every practical system known at the present time, including the low tension direct, the storage battery and the alternating at 1,000 and at 10,000 volts in the primary circuit. After duly considering all the arguments advanced by each company in favor of its own particular system, Major Marindin has solved a very knotty problem by granting to each company nearly in full the demands made, and in only two cases were the demands refused entirely. It is but natural to suppose that where systems differ so widely as those above enumerated, their promoters would, in their bids for preferment, employ every argument possible to influence a decision in their favor, and such was the case during the present hearings. It seems, however, that Major Marindin has taken a sensible view of this question of "dangerous currents," and has looked upon it not simply in the light of their danger, but in the more sensible and progressive spirit which looks to the best means of making them safe. Thus, commenting on the pressure of 10,000 volts proposed to be carried on the Ferranti. Deptford station, Major Marindin remarks: "A few years ago the pressure of some 200 volts was considered to be the limit of safety. This company has for some time been working safely and successfully at a pressure more than ten times this amount, and as the so-called experiment of still further raising the limit of pressure would, if successfully carried out, be of immense benefit both to the public and electric lighting undertakers, I do not consider that, under proper regulations, the London company should be prevented from carrying out a scheme in which they have shown the greatest confidence." Such an expression coming from an entirely independent source, and one usually looked upon as conservative to the utmost degree, is a hopeful sign that the promised better time for electric lighting in England has actually come.

Inventions and Trusts. IN our issue this week we give Mr. Erastus Wiman's interesting talk on the subject of the telegraph and the telephone. It will be remembered that two weeks ago we cited his advocacy of an electrical trust, from the same address, delivered before the New York Electric Club. It is cheering to see so able a man as Mr. Wiman enthusiastic in his appreciation of the benefits of electricity, whether the service be that of the telephone and telegraph or that of electric light and power; but, as we said before, we find it impossible to agree with him in his views as to the beauty and advantage of an electrical trust. In the preceding part of his address, Mr. Wiman based his argument for a trust on the statement that electrical stocks were low in value and could not be pledged. This we showed to be quite incorrect. In the passage we now cite, Mr. Wiman himself supplies a pointed argument against his proposed trust. He says it was a great blessing that the telegraph and telephone were early divorced, "because I do not believe that the telephone would ever have been developed to one-quarter the extent to which it has been developed if it had been dependent on the telegraph." Those are exactly our sentiments. Mr. Wiman goes on to show a little later how the Western Union Company discourages invention. "To day the Lord help the man who goes to the Western Union with a new scheme," says Mr. Wiman, and we leave him to reconcile that pious ejaculation with his theory as to the call for an electrical trust to do the industry good. What electricity stands in need of to day is not the repressive spirit that sits down at once on the man with the new idea, but the encouraging spirit that tenders a helpful hand to every inventor of genius and high aspiration. We shall never have too many inventions in electricity, but, under the régime of Mr. Wiman's trust there would soon be too few. Our patent record, week by week, shows how active is invention in the electrical fields. What would be the stimulus or encouragement to all these persevering inventors, producing new apparatus and appliances for the good of mankind as well as for their own benefit, if they were at the mercy of "a hard-headed set of men on new schemes" bent on "discouraging speculation or inventive enterprises" by all means in their power?

"ELECTRICAL WORLD" PORTRAITS.—VI.

ELMER A. SPERRY.

The remark was made in the last sketch in this series of biographies of living American electricians, that it was not until recently that men had risen to prominence and influence in electrical work who were without practical telegraphic affiliations. At the present time the rapid and widespread utilization of electricity, however, has called a new class of inventors and electrical engineers to the front, some of whom are still so evidently at the beginning of their careers, that their achievements as young men become matter of surprise. These new men not only are highly trained mechanical or civil engineers, but superadd a thorough knowledge of electricity, which is still rare, while in one or two exceptional instances, their display of inventive genius and of adaptive ability has been of the highest order.

Mr. Elmer A. Sperry, the subject of this sketch, is a leading member of the "new school," and is, unless we are mistaken, the youngest electrical engineer and electrical inventor of widespread reputation in this country. He was born October 12, 1860, at Cortland, N. Y., of American and German parentage, his father being a man of great mechanical skill, and his mother, of German descent, a mathematical graduate from Rutgers College. Owing to his mother's early death, young Sperry was brought up by his grandparents, who from the outset found the greatest difficulty in controlling his passion for mechanics and in inducing him to study books as well as tools and machinery. The tendency was too strong to be checked, however, and broke forth not only in improved apparatus for games and in devices, by which the "servant girl problem" was to be solved and house-keeping made easy, but in windmills, drills, and a variety of implements. With boyish zeal he also mastered the art of bookbinding while familiarizing himself with modern machine shop and foundry practice, and such spare time as he had from all this, to say nothing of work on a glass-blowing and grinding machine, air pumps, and a railway tricycle, was devoted to the operation of a private Morse telegraph line.

The taste for electricity was acquired at this juncture, and young Sperry felt that he must drink deeper of that spring. He bought books, built apparatus for experiment and constructed an electric motor, but was not satisfied until he began his electrical education in good earnest at the State Normal School, at Cortland, where, happily, his strong natural bent was encouraged, and where he attained an excellence in mathematics, chemistry and physics that was not to be despised. Subsequently he pursued investigations and studies at Cornell University, located only some 20 miles from his home, attending lectures there and keeping himself *au courant* with all the special researches and experiments going forward at that place. In fact, his attendance upon the lectures on electricity and magnetism of Prof. W. A. Anthony, then Professor of Physics at Cornell, amounted practically to a course in electrical engineering, such as is now given a distinct and separate place in the University curriculum.

About this time Mr. Sperry undertook his first electrical contract, which consisted in recording automatically the movements of a gasometer some miles distant, by means of a single electrical wire, and the task was successfully carried out. He also built telephone lines and instruments and put them in operation, but his attention was claimed principally by dynamo-electric questions. In studying the principles of construction he was impressed with the apparently large part of dynamos left inactive, and, with the aid of rude models and mathematical principles, he set to work to correct the defect. His ideas were reduced to plans and drawings in 1878; further principles developed themselves to his mind; the aid of capital was secured, patents on economic generation and automatic regulation were applied for in 1880 and 1882; and the form of Sperry dyname-electric machine was adopted that has since been steadily adhered to, namely, one in which the double field magnet is a conspicuous feature.

The Sperry system of arc lighting was first successfully exhibited at Cortland on Christmas Eve of 1880. Shortly after Mr. Sperry proceeded to Chicago, where flattering inducements were held out, and during 1883 a company was formed to place the apparatus on the market. The system was very well received, a great many plants were sold, and large contracts came in, but dissension arose in the company, and the commercial operations of a most promising and profitable enterprise were seriously impeded. Mr. Sperry was not daunted, however, but worked on quietly at many new inventions in lighting, power, regulation, braking, etc., whose details were carefully filed away; and he also had his time well occupied by a number of heavy electrical engineering operations. It was during this period that he instituted and personally operated, both as engineer and financial manager, the largest electric light station in Chicago, all the lines being underground and covering a large district in the business portion of the city. Such establishments as the Chicago *Tribune*, the *Inter-Ocean*, and Kinsley's famous restaurant, were thus lighted by the Sperry system. About this time, too, Mr. Sperry was awarded the contract for lighting the huge building of the Chicago Board of Trade, where the lights are now in daily operation, and he also gave the building the magnificent coronal of lights which for more than a year illuminated the tower and a large portion of the city, being 303 feet from the ground, and of 45,000 candle-power. This crown of light was often seen from the Michigan shore, and brightened the harbor for many a weary mariner. His work in connection with this plant, at such a height, and the opportunity for the study of static electricity and atmospheric discharges, led him to the construction of his well-known lightning arrester.

Recent changes in the personnel of the Sperry Company have placed its affairs in the hands of business men of the greatest energy and enterprise, and as a result not only is the apparatus in demand but Mr. Sperry has been able to complete it and to bring out many ingenious contrivances. Lamps, automatic devices, safety appliances, improvements in detail and various novelties have all been perfected in an incredibly short time.

It may be added that in addition to his systems of light and power, Mr. Sperry is the inventor of an automatic gas engine, an electric mining machine—described later in this issue, with other apparatus—an automatic ground switch for electric light lines, and an entirely new system of district messenger telegraph appliances, embodying an automatic grounding system which allows every station to be heard from, even when the main line is broken.

ELMER A. SPERRY.

Mr. Sperry is a charter member of the American Institute of Electrical Engineers. He was the Chairman of the Committee of Call for the first meeting of the National Electric Light Association in Chicago, and is intimately connected with the history and work of that body, which has now become so important and influential in electric lighting matters in this country. He is also a member of the Chicago Electric Club, in whose affairs and scientific discussions he is frequently called upon to participate. Being a ready thinker and speaker, with abundance of data at hand, he has often been requested to lecture upon the topics of his profession, and one of his chief pleasures is to perform electrical experiments for his friends—among whom are the newsboys. Mr. Sperry says that the boys are attentive listeners, keenly enjoying an experiment, and grasping an idea at once, especially in its business bearings and on its humorous side.

In 1887 Mr. Sperry married Miss Zula A. Goodman, daughter of Mr. Edward Goodman, senior proprietor of the Chicago *Standard*; and he has one daughter.

Magneto Morse Sounder.

Mr. Campbell Swinton has recently constructed a magneto Morse sounder, on the principle of his magneto bell. The play of the transmitting lever is made less, and the bell hammer is made to hit against two buffers, arranged to give different notes when struck. The absence of battery will make the magneto sounder exceedingly useful for field telegraphing, and the instrument has been sent to the English War Department at Chatham to test.

Cardew's Safety Device for Transformers.

One of the great dangers with alternating currents is that the primary current may by some accident get into the secondary circuits by defective insulation in the transformers. Captain Cardew has devised an ingenious instrument, which is being made by Messrs. Drake & Gorham, London, to obviate this defect, and cut out the whole circuit if such an accident were to happen. It consists essentially of a very thin piece of aluminium foil, in the shape of two discs joined by a strip, lying loosely between two metal plates insulated from each other. These plates are connected respectively to the secondary circuit and to earth. If such an accident as that mentioned take place, the thin disc is attracted by electrostatic action due to the high potential of the primary, and touches the top plate, immediately connecting it to earth through the bottom plate. The slight leak to earth of the primary causes a fine fuse to go, and this short-circuits for a moment the primary, which, of course, causes both fuses to go and cuts out the transformer and the whole installation at the main fuse.

On the Concentration of Electric Radiation by Lenses.

At the meeting of the London Physical Society, held on May 11, Prof. O. J. Lodge, F.R.S., and James L. Howard, D.Sc., read a paper on the above subject. The authors' first attempts at concentration were made with mirrors on a comparatively small scale, and, owing to the difficulties experienced, it was considered desirable to try lenses. Two large cylindrical ones of plano hyperbolic section were cast of mineral pitch in zinc moulds, the plane faces being nearly a metre square, the thickness at vertex 21 centimetres, and each lens weighed about 3 cwt. The eccentricity of the hyperbola was made 1.7 to approximate to the index of refraction of the substance. The lenses were mounted about 6 feet apart with their plane faces parallel and towards each other on a table in the college corridor, and an oscillator was placed about the principal focal line of one of them at a distance of 51 centimetres from the vertex. The field was explored by a linear receiver made out of two pieces of copper wire mounted in line on a piece of wood, and the air gap between their inner ends was adjustable by a screw. When the oscillator worked satisfactorily the receiver would respond to about 120 centimetres, and with the lenses the distance was 450. The receiver responded anywhere between the lenses, and within the wedge between the second lens and its focal line, the boundaries being clearly defined, but no special concentration was noticed about the focus. Interference experiments were carried out by placing a sheet of metal against the flat face of the second lens and determining the positions of minimum intensity between the lenses. The distance between these points was 50.5 centimetres, corresponding with a wave length of 101 centimetres, whereas the calculated wave length of the oscillator was 100 centimetres.

Prof. FitzGerald congratulated the authors on their success, and also pointed out that although large oscillators give good results at distances within a few wave lengths, yet at greater distances small ones were decidedly superior, owing to the energy of radiation varying as the fourth power of the rapidity. He had recently made experiments on electric radiations analogous to Newton's rings, and had successfully observed the central dark spot and the first dark band. Referring to Dr. Lodge's experiments, he inquired whether any traces of diffraction were observed near the boundary of the bundle of rays between the lenses. Speaking of the polarization experiments, Prof. FitzGerald said waves reflected from films of water exhibited no polarization, whereas those reflected from non-conductors were completely polarized.

In reply, Dr. Lodge said no diffraction effects had been observed, but in the interference experiments to determine wave length, the positions of minimum effect were very decided.

Recording Voltmeter.

A recording Cardew voltmeter is being made by Messrs. Drake and Gorham, in London, in which the long fine wire inherent to this class of voltmeter is made to go over a series of small pulleys and then acts upon the end of a pointer. This makes the instrument much more compact than the ordinary form. A spring bar takes up the slack, and the readings can be adjusted as desirable. The variations of potential of a battery or circuit can be continuously recorded by passing a strip of lined paper slowly past the pointer. The moving power for feeding the paper will be obtained from an electric pendulum, the impulses from the electro-magnet being given about once a minute by a small trailing piece, which catches in a little slot, and touches two contacts together, when the swing gets below a certain amplitude. Our readers will remember a similar instrument constructed by Richard, of Paris, and described in our columns a short time ago.

Electric Fountains at the Paris Exposition.

In a recent letter our Paris correspondent made mention of the fact that the electrical fountains at the Paris Exposition had gone into operation, and were attracting widespread attention from their magnitude and beauty, in both of which respects they are said to surpass any similar installation ever devised. The fountains may be described as a combination consisting of two parts, one the French, and the other the English, the latter being erected by and

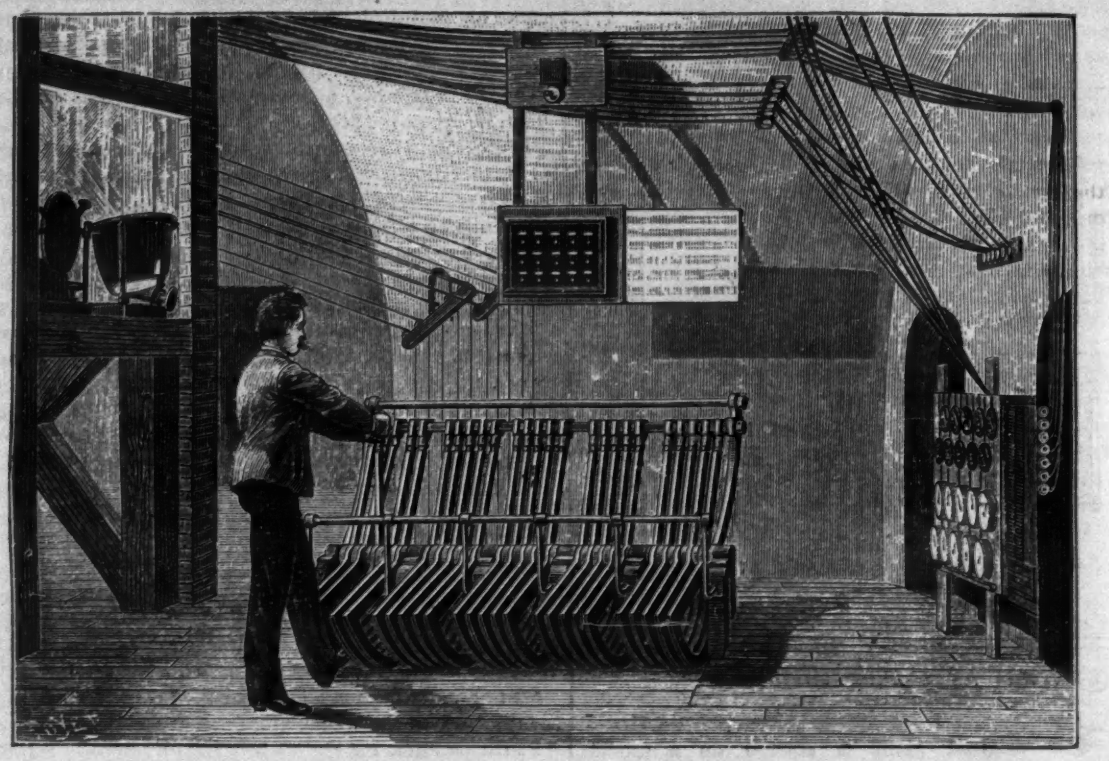


FIG. 2.—OPERATING ROOM UNDER THE ELECTRIC FOUNTAIN, PARIS EXPOSITION.

according to the designs of Mr. Galloway, whose electric fountain was in operation at the Glasgow Exhibition during 1888. The general plan of the fountain will be seen from the illustration, Fig. 1, which shows a bird's-eye view. The upper end, raised above the lower, represents the French part, and contains an allegorical group situated within a large basin. Below this is a second rectangular basin about 135 feet long, which ends in a third octagonal basin on the same level. In the upper basin the water is emitted from four horns of plenty, four dolphins and six urns, forming altogether fourteen parabolic, horizontal jets. Besides this there are two vertical jets placed on each side of a ship representing the "City of Paris" in the allegorical group. Along the edge of the central rectangular basin there are

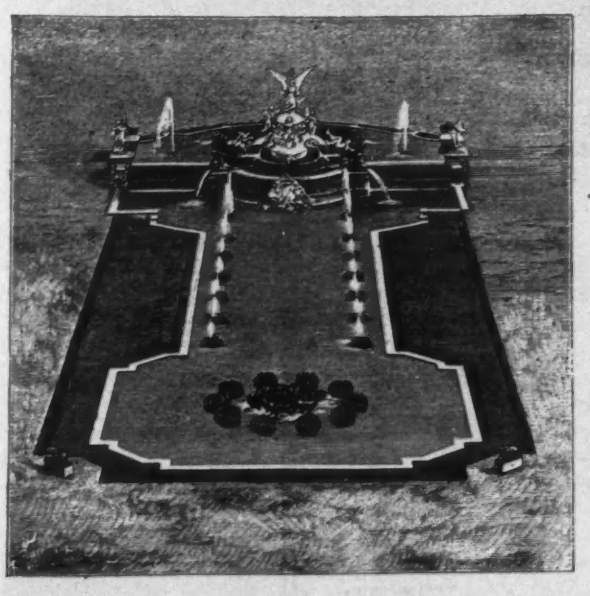
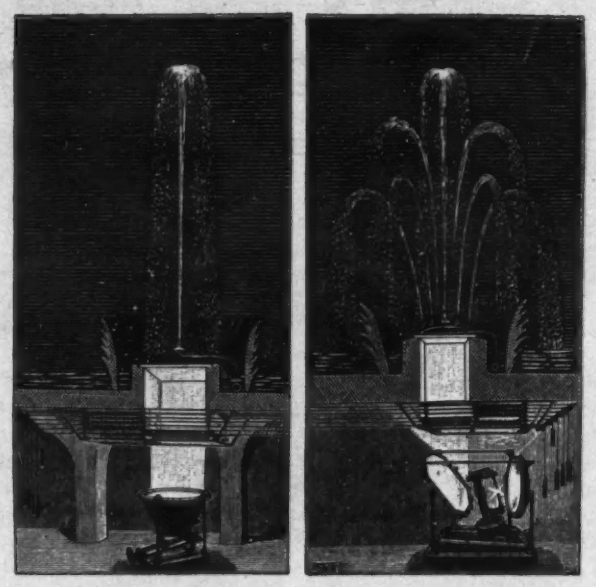


FIG. 1.—BIRD'S EYE VIEW, ELECTRIC FOUNTAIN, PARIS EXPOSITION.

14 composite jets, each of which is composed of 17 small jets, so arranged as to break into fine spray around the central jet, which rises above the rest. Finally, the octagonal basin contains two concentric jets arranged in circles, the inner of which contains six jets and the outer ten. In the centre there is placed an immense double jet.

It will thus be seen that the fountain is composed of 33 vertical jets and 14 parabolic, comprising nearly 300 spouts, from which the water escapes at the rate of 350 litres per second. The water which supplies the fountain is taken from the reservoir of Villejuif, situated at an altitude of about 300 feet above the fountain.

The illumination of the jets is effected by means of 17 arc lamps taking 60 ampères of current, which are employed in the English portion of the fountain, the octagonal; and of 30 lamps of 40 ampères for the remainder of the fountain, comprising the French section This would give an illuminating capacity of very nearly 250,000 c. p. and requiring 250 h. p. for the operation of the lamps. Our engraving, Fig. 2, taken from *La Nature*, shows the subterranean chamber under the fountain. The chamber contains all the switches and necessary apparatus for changing the colors by means of the interposition of colored glass in the path of the projected light. The manner in which the jets are illuminated is shown in the engravings, Figs. 3 and 4, which show respectively the Galloway and Sautter-Lemonnier systems of illumination for the vertical jets, both of which are employed. Fig. 5 shows the method of illuminating the horizontal, parabolic jets designed by Mr. Bechman, assisted by Mr. Richard. These latter are arranged so that the light reflected from below is thrown into a jet of water at its centre and is totally, internally reflected so as to make the jet of water appear like a jet of molten metal, the effect being wonderfully fine.



FIGS. 3 AND 4.—GALLOWAY AND SAUTTER-LEMONNIER SYSTEM OF JET ILLUMINATION.

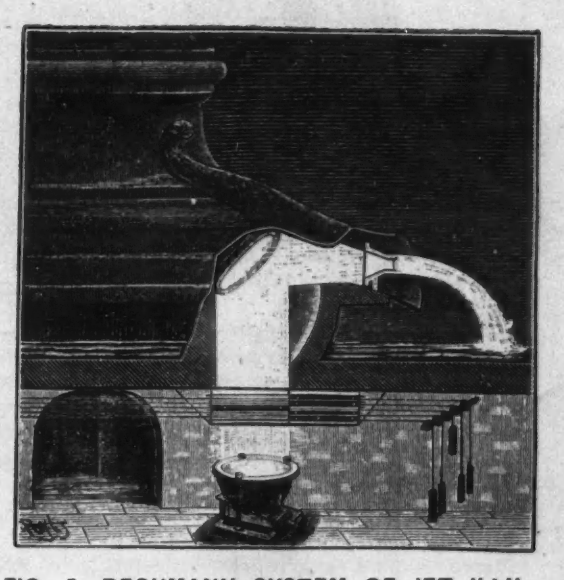


FIG. 5.—BECHMANN SYSTEM OF JET ILLUMINATION

On the Influence of the Density of the Acidulated Water in an Accumulator.

BY LEONARD PAGET, PH. D.

That the density of the acid solution in an accumulator has considerable influence on its electric capacity has been known for some time, but authorities have differed as to the density corresponding to a maximum capacity.

In the earlier days of the storage battery, M. Planté used and recommended a 10 per cent. solution of sulphuric acid in water; in present use there is frequently as high a percentage as 15 to 25. Reckenzaun advocates a density of 1.2 as giving maximum capacity.

It is due to Professor Heim, of the Electro-Technical Institute at Hanover, that he has set this question at rest by a series of exhaustive measurements on two types of accumulator, the Tudor and the Electric Power Storage Company's, under technically equivalent conditions. The Tudor accumulator was filled with 2.73 cubic decimeters of 15 per cent. acid solution (by weight), the E. P. S. accumulator with 2.3 cubic decimeters. The capacity was 53.7 ampère-hours for the former, and 50.8 ampère-hours for the latter. There appears, therefore, a proportion of 50.8 cubic centimeters of liquid per ampère-hour in the first case, and 45.3 cubic centimeters in the second. These figures correspond closely enough with theoretical data.

In order to judge of the influence of the density of the acid solution, this was increased by steps of 5 per cent. each from 10 to 35 per cent., a series of charges and discharges being taken with each increment, with an average interval of 15 to 18 hours between charge and discharge. The current was kept constant by a resistance in circuit. The charging was carried on until the disengagement of gas was abundant. The discharge was stopped at a 10 per cent. fall or "drop" of the electromotive force from its initial value.

The following tables give the results expressed as averages of several experiments that were concordant within one-half per cent. for the voltage and within 3 per cent. for capacity. The figures are concordant for both accumulators.

TUDOR ACCUMULATOR.

	Density of the liquid before charging at 15° C.					
	1 069	1.097	1.134	1.172	1.222	1 261
H_2SO_4 per cent. (by weight)	10.1	13.9	18.7	23.7	29.9	34.6
E. M. F. at commencement of discharge, volts	1.980	1.998	2.027	2.065	2 109	2 145
Terminal potential difference in volts	1.923	1.945	1.967	2 004	2.047	2.085
Discharge capacity in ampère-hours	47.4	53.8	53 4	49.5	42.1	32.8
Electric energy in watt hours	88.8	102 2	102.9	97.2	84 5	67.3
Charge in ampère-hours	51.0	55.5	54.7	51 3	46 5	37.5
Electric energy expended in charge in watt hours	106.7	116.3	117 6	112.1	103.9	84.3
Efficiency by quantity per cent	93.0	96.9	97.6	96.5	90.6	87.5
Efficiency by energy per cent	83.2	87 8	87 6	86.7	81.4	79.8
Density of liquid after the charge at 15° C.	1.109	1.140	1.176	1.207	1.252	1.285

E. P. S. ACCUMULATOR.

	Density of the liquid before charging at 15° C.				
	1.069	1.101	1.139	1.175	1.225
H_2SO_4 per cent	10.1	14.4	19.4	24.1	30.2
E. M. F. at the commencement of discharge, in volts	1.980	2.001	2.025	2.065	2.104
Terminal potential difference in volts	1.916	1.936	1.960	1.993	2.035
Capacity in ampère-hours	46.2	50.7	43.7	37.1	28.5
Electric energy in watt hours	86.0	96.0	84.0	72.9	56.8
Density of the liquid after the charge at 15° C.	1.113	1.146	1.179	1.207	1.249

The curves that can be produced by plotting out the above figures show that the difference of potential increases proportionally with the density of the acidulated water. It is noticeable that while the curve of the difference of potential indicated nothing remarkable, the specific resistance of the liquid varies greatly, another proof that the internal resistance of an accumulator depends mostly on the surface of the plates and very little upon the liquid. The figures obtained also show that the capacity rapidly increases as the strength of the acid is increased, from 10 to 14 per cent., attaining a maximum between 15 and 16 per cent., and subsequently decreasing as the strength of the acid exceeds these values. The maximum electrical energy occurs at a little above 16 per cent.

With 25 per cent. of acid, the plates, the positives especially, had not so good an appearance as with liquid of lower density, and above 20 per cent. the capacity had noticeably diminished. Wishing to ascertain the cause of this diminution, Prof. Heim made the following experiments. The E. P. S. accumulator after three charges and successive discharges with water acidulated to 30 per cent., at which the capacity had been 28.5 ampère-hours, was refilled with liquid of 13.5 per cent. But as the plates were still impregnated with the liquid of the preceding experiment, the density was raised thereby to 1.114,

corresponding to 16 per cent. The first two trials gave a capacity of 39.8 ampère-hours instead of 50 ampère-hours, previously obtained. The cells were then charged for a long time with about 210 ampère-hours, and after two charges and discharges, the capacity returned to its previous value. Similar trials with the Tudor accumulator gave like results. Prof. Heim explains these facts by the concentrated acid giving rise to a large quantity of sulphate of lead, which diminished the capacity. After a long charge and with a liquid weaker in acid all this sulphate is reduced and the capacity is found at its original value.

Finally, Professor Heim makes a very important remark. An accumulator filled with acid of 9.6 per cent. (1.064 sp. gr.) before charging had a capacity of 51.8 ampère-hours, an increase of 7.9 ampère-hours, or 15.3 per cent., for a difference of acid strength of 6.4 per cent. The writer, who has abstracted these points from Professor Heim's very much more elaborate paper, has confirmed the deductions for several other types of "pasted plate" battery; but from a series of experiments with a well-formed Planté cell, he has arrived at the conclusion that the strength of solution recommended by M. Planté, should not be departed from. In fact, he finds that above 13 per cent. of acid the capacity can be said to diminish in the case of a plain lead Planté cell, and that about or between 9 to 10 per cent. gives the maximum capacity. There is, however, the difficulty in these trials of obtaining a fully formed cell. But returning to a higher percentage of acid after using a ten per cent. solution appears, in the case of a plain lead Planté cell, to noticeably reduce the capacity.

The New Thomson-Houston Station, Salem, Mass.

One of the most interesting features of the present rapid development in electric lighting is the manner in which small stations are enlarged and old ones rebuilt. The original plant is started on a modest scale, but the popular appreciation of the light comes sooner than is expected, and the company finds itself compelled to live up to its larger opportunities. Very often, too, the capital for the plant is reluctantly provided, but the skill and energy of the management rapidly make it evident that the business is profitable, and then there is an eager readiness to increase the investment.

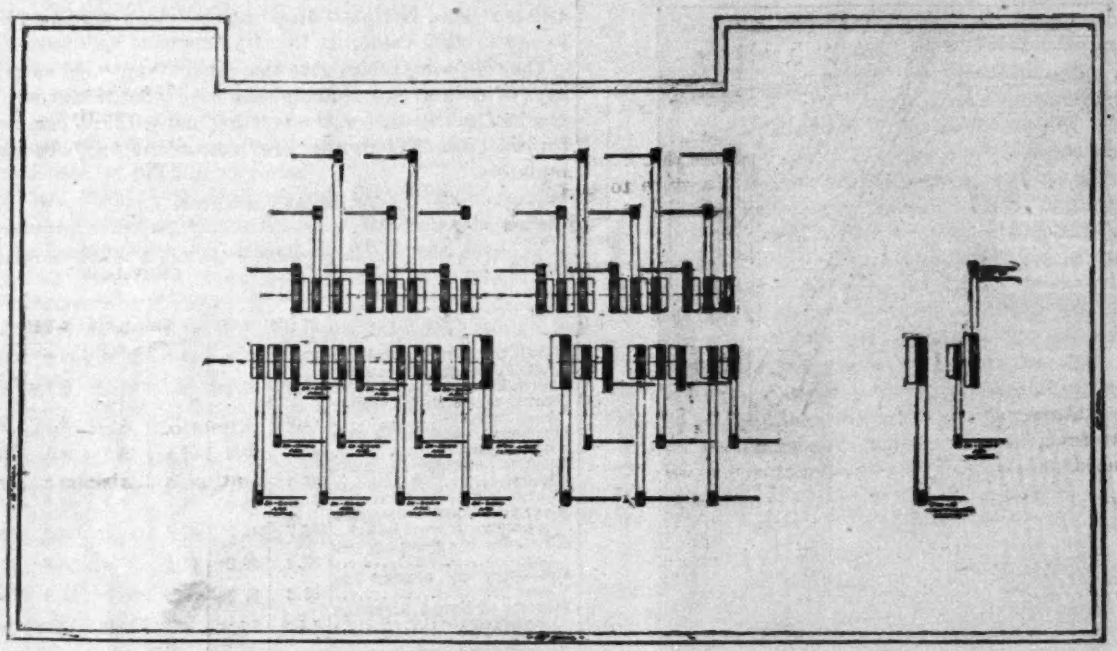


FIG. 1.—THE NEW THOMSON-HOUSTON STATION AT SALEM, MASS.

Among the companies that have lately been compelled to build new stations is that at Salem, Mass., and the cuts shown herewith illustrate the station that has been designed and equipped on the most approved principles by the Thomson-Houston Electric Company.

Owing to the shape of the lot of land owned by the Salem Electric Light Company, it was deemed expedient to erect two buildings. The boiler house, therefore, has been made independent of the building containing the engines and dynamos. The engine and dynamo-house is two stories high, the first story, Fig. 2, where the engines are situated, being 14 feet, and the second, Fig. 1, where the electrical apparatus is placed, being 12 feet. This building is built of brick throughout, and is 103 feet long and 56 feet wide. The boiler house is 92 feet long, 54 feet 4 inches wide, and 23 feet high. The chimney is 130 feet high, 6 feet diameter inside, and 13 feet square at the base. The foundations are rubble stone placed on piling capped with concrete. Seven hundred and ninety-eight spruce piles were used under the main building, and 52 oak piles under the chimney.

The steam plant, which is compound condensing, consists of one 370 h. p. double tandem compound engine, made by McIntosh & Seymour, and one 150 h. p. high pressure Fitchburg, now in use in the present station. The boilers were made by the Cunningham Iron Works, and are 3 in number, 6 feet in diameter, 17 feet long, and 125 h. p. capacity each.

The auxiliary steam apparatus consists of one 1,200 h. p., surface condenser, a Knowles air and circulating pump, and a feed water heater situated in the smoke flue.

The station is built to allow the addition of 1,000 h. p.; and there is room for nine additional boilers and another line of shafting. The station has a capacity of 42 dynamos. At present there will be 14 in use; 11 arc and two alternating current machines, and one generator for railway work. On the second floor are the store and testing rooms, and the superintendent's office.

A coal shed will be built in the rear of the boiler-house, which will have a capacity of 1,500 tons and a track constructed for bringing coal from the shed to the boilers.

No pains will be spared to make this station, even to the smallest detail, a model of its kind, and it will be one of the finest electric light and power stations in the New England States.

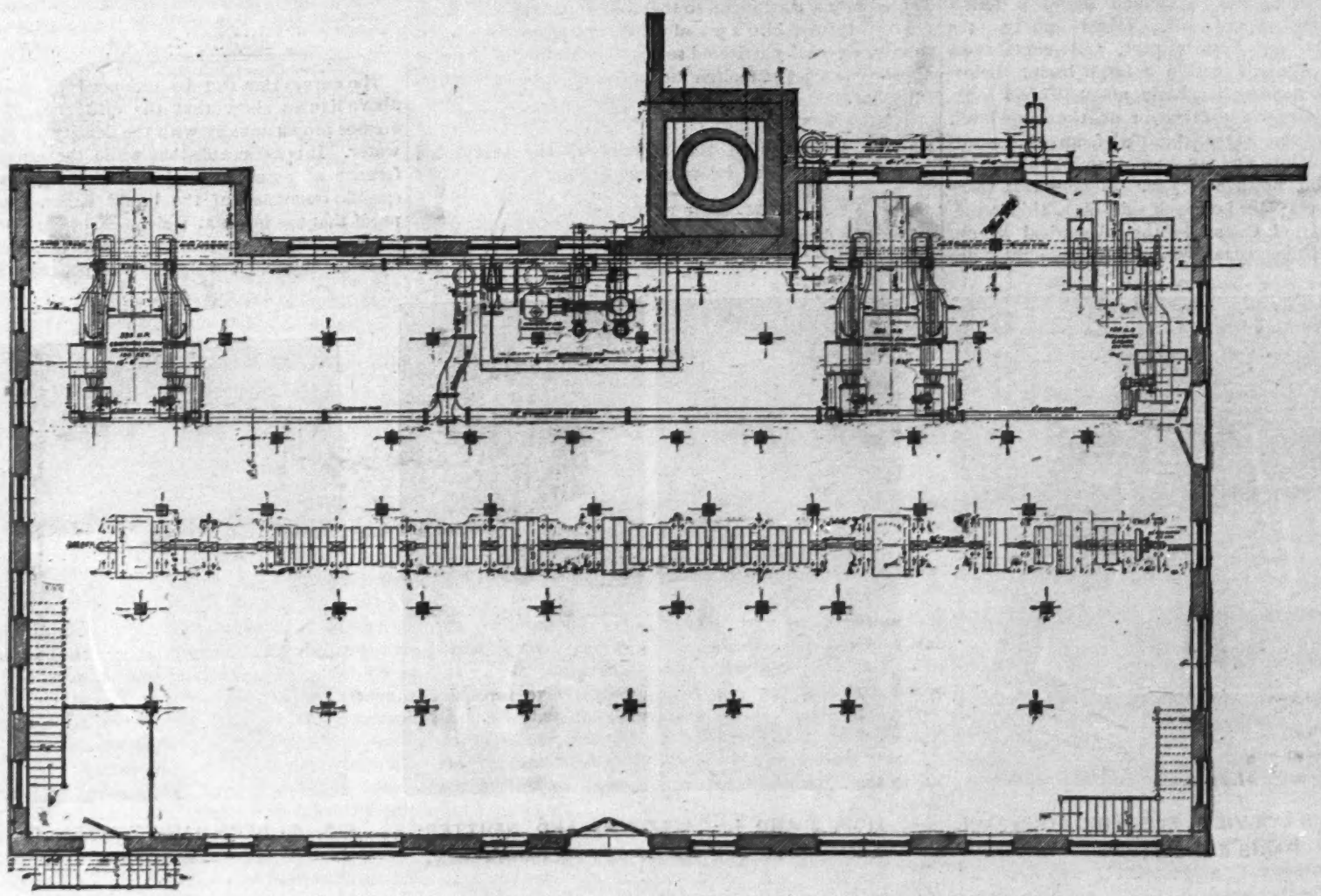


FIG. 2.—THE NEW THOMSON-HOUSTON STATION AT SALEM, MASS.

Ampere-Feet and Ampere-Turns.

To the Editor of The Electrical World:

SIR: Kindly inform a constant reader of your paper of the meaning of the terms, ampère-feet and ampère-turns.

PHILADELPHIA, Pa. I. G.

ANSWER: These are terms employed to designate the amount of the winding of field magnets of dynamo machines and similar apparatus, and upon which their magnetic intensity depends. The "ampère-turns" of a magnet means the strength of current in ampères circulating in the magnet wire, multiplied by the number of turns which the wire makes around the magnet. Thus, for example, a magnet wound with 250 turns of wire through which 10 ampères are passing, is said to be energized by $10 \times 250 = 2{,}500$ ampère-turns. "Ampère-feet" is a term analogous to the former but signifying the number of ampères passing through the wire, multiplied by the number of feet of wire wound on the magnet. Thus in the case of the magnet above, if it had been so wound that the mean effective diameter of the winding on the core had been 6 inches, or 0.5 foot, the number of ampère-feet would have been $10 \times 250 \times 1.57 = 3{,}925$. The figure 1.57 stands for the circumference of a turn or circle 0.5 foot in diameter.—EDS. E. W.

The Sperry System of Electric Lighting.

As a rule, radical departures are dangerous, but where they are based on careful analysis of the object to be attained, in competent hands, they often lead to innovations of great value and are the basis of all true advancement. The Sperry system of electric arc lighting is the result of experiment extending over a period of eleven years. In 1878 and 1879 the first inventions were made, involving some of the principal features which have since proved so valuable in connection with this system, and and which constitute the marks of distinction that separate it from other systems of electric lighting.

The forms of armature and field and the method of mounting the same which had come to be recognized as standard were laid aside, and an original method was adopted which seemed to the mind of the inventor to accomplish the desired result in the simplest and most direct manner possible. It is truly remarkable that each successive step in the perfection of the general theory of dynamo machinery has applied perfectly and has helped to explain more fully the reason for the high efficiency and economy of material in the Sperry dynamo. The theory of the magnetic circuit recently brought to a conclusive demonstration by Kapp, the cutting of the lines of force, and the internal dead wire of annular armatures fully brought out by Hering in his recent work upon the subject, and the earlier mathematical theories advanced by Silvanus Thompson, have all gone to show in one way and another that the theory upon which the design of the Sperry generator is based is sound and thoroughly worked out in every detail. In designing the machine the old principle laid down by Faraday relative to the cutting of the lines of force by the active wire was taken as a basis.

The latest type of the Sperry dynamo is illustrated in the accompanying engraving, Fig. 1, and Fig. 2 shows the structure of the magnetic frame with the armature removed. The armature itself is shown in two views in Figs. 3 and 4.

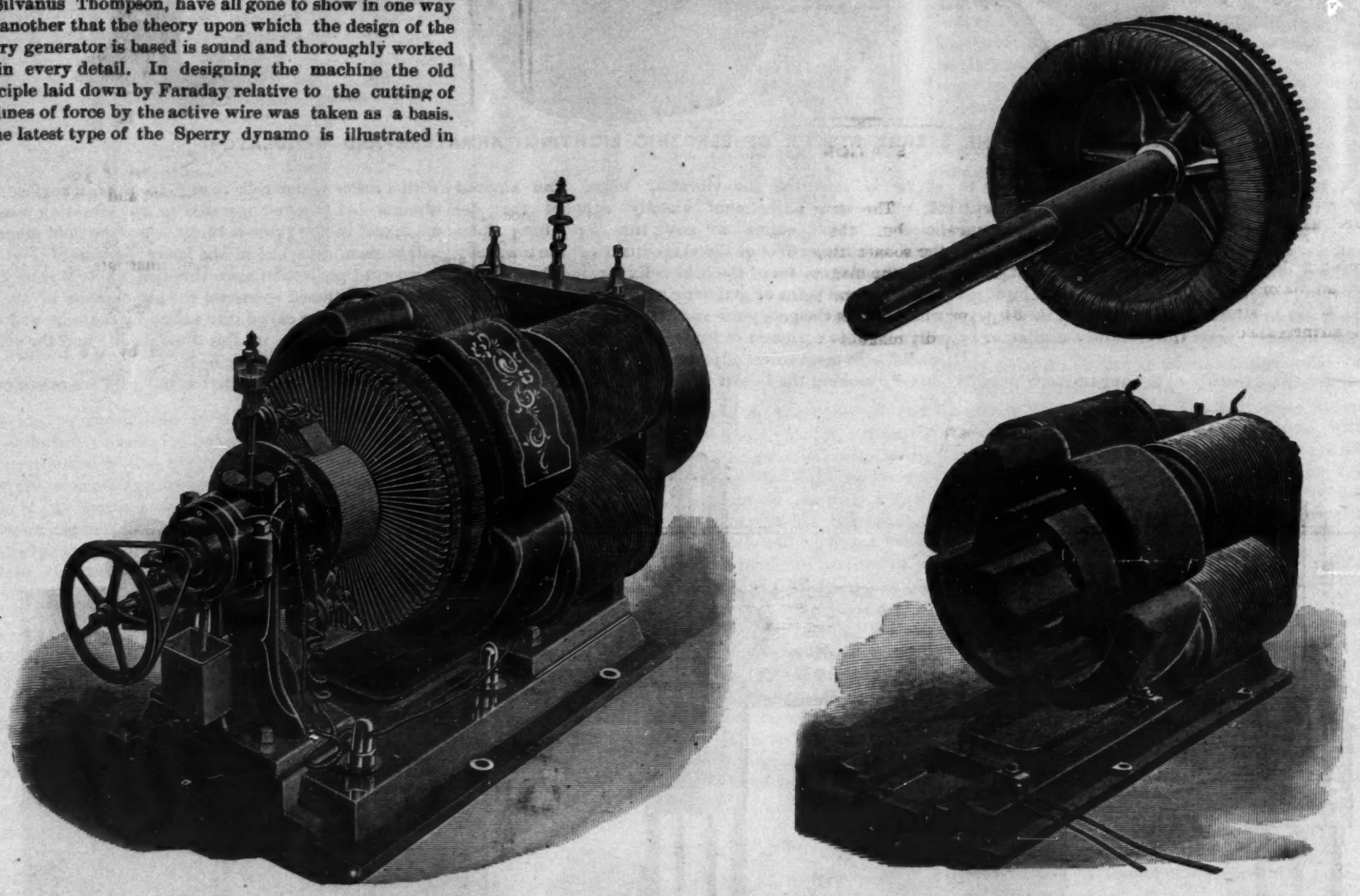
In an analysis of the Sperry generator it will be seen that the wire which is to revolve in the presence of the field magnets is placed at a good distance from the axis of rotation in such a manner that a high peripheral velocity is obtained with a comparatively low rate of revolution of the armature shaft, thereby wasting as little as possible in friction at the journals; and depreciation of the wearing parts of the machine is avoided. Secondly, the presenting the greatest possible percentage of this generating conductor to the magnetic masses or pole pieces of the field magnets compels the induction in the space occupied by the generating conductor to be the highest possible, and at the same time makes the resistance of the magnetic circuit of the machine the lowest possible. The design also avoids undue accumulations of the strands of the conductor at any point upon the armature which would tend to remove the pole pieces from the magnetic mass forming the core of the armature; it also submits the greatest possible surface of the pole piece to the armature core for the radiation of its lines of force, and more nearly thereby closes the magnetic circuit and reduces the resistance of such circuit to a minimum, requiring but a small expenditure of energy in the field helices for the maintenance of the required induction throughout the entire magnetic path. The comparative area of pole piece per pound of wire upon the armature, in the case of the various machines as compared with the Sperry, is, according to the inventor, as 100 to 211. The entire absence of overlapping of the coils is of great practical value. In case of injury sustained by one coil it will not cause the destruction of the whole armature, as the injured part can easily be removed and replaced without disturbing any other coil and without unwinding the whole armature down to this point, as in case of most forms of the cylindrical armature.

The following are some of the results obtained with the Sperry apparatus which bear out the correctness of the principles involved. For instance, with a velocity of conductor of 2,500 feet per minute it requires 1.55 feet per volt, including the entire wire upon the armature, and connections and commutator. The absence of immense masses of wire piled up on the ends of the armature, which cause accumulation of heat, reduces the square mils per ampère required on the Sperry armature to the low point of 135 mils per ampère on the exterior circuit, and 270 per actual ampère circulating in the wire upon the armature. Fifty-four pounds of insulated copper conductor is all that is required for the generating of 27,700 watts, being considerably over 500 watts per pound, including all conductor upon the armature. In the field 62 watts per pound of conductor is developed. Ninety-two per cent. of each convolution upon the armature is available for the production of electromotive force, $\frac{23}{25}$ of the entire electromotive force being produced by that portion of the armature coil which is on the interior of the core. This has been demonstrated by careful tests, in which the machines have been constructed so that either the internal or external pole pieces could be removed and the resulting electromotive forces observed. The field magnet is operated at that particular degree of saturation where the highest efficiency and economy is obtained. It is constructed of superior materials that long experience has proven to be the best combination, and the exact relation of the pole pieces to the cores has been settled upon by an elaborate series of experiments.

The leaving of the inside of the armature free to the pole pieces is valuable for ventilation, and in thus keeping the armature cool its electrical resistance is reduced and the danger of burning is avoided. The curve of electromotive force from one brush to the other constitutes on the two sides almost a perfect circle, eccentric and tangent to the two circles representing respectively the extreme potentials. The difference of potential of each consecutive segment in the commutator is nearly uniform. The Foucault currents and waste of energy in the armature core have been reduced to a minimum, this waste not exceeding 1.8 per cent. in the tests which have been recently conducted. The commercial efficiency is higher than is generally met in arc apparatus, being upwards of 86 per cent.

The dynamos are so constructed as to be operated several in series upon a single circuit. This greatly reduces the expenses of construction, as modern practice in insulation admits of high electromotive forces being employed. The total electromotive force upon the line being generated at several points is considered more reliable than when generated within the terminals of a single machine. It will be noticed from the above that owing to the small amounts of material required in proportion to the extremely large output of the machine, the machines are comparatively inexpensive to construct. Not only does this feature affect the manufacturing first cost, but it is this also to which the high commercial efficiency is due, and which makes a constant saving in fuel account to the consumer. The balance of inductive effect of armature and field has also been carefully adjusted by a series of experiments. The ratio settled upon has been such that the commutator brushes do not spark at any point upon the commutator when the load does not greatly exceed the rated capacity of the machine. It enables the electromotive force to be controlled perfectly by rotating the brushes, the commutator at the same time wearing to a dull glaze.

The plates of the armature core are made of thin iron, well annealed, and each carefully insulated from the other, and the whole mass supported by bolts which project from the edge and which are used to support the whole to the gun metal spider by means of which it is mounted upon the armature shaft. The strains upon the bolts are so arranged as to be within the metal itself, permitting of their being tightened down to such an extent as never to require the least attention. Experience with hundreds of machines constructed upon this principle shows that this system of mounting is an absolute success.



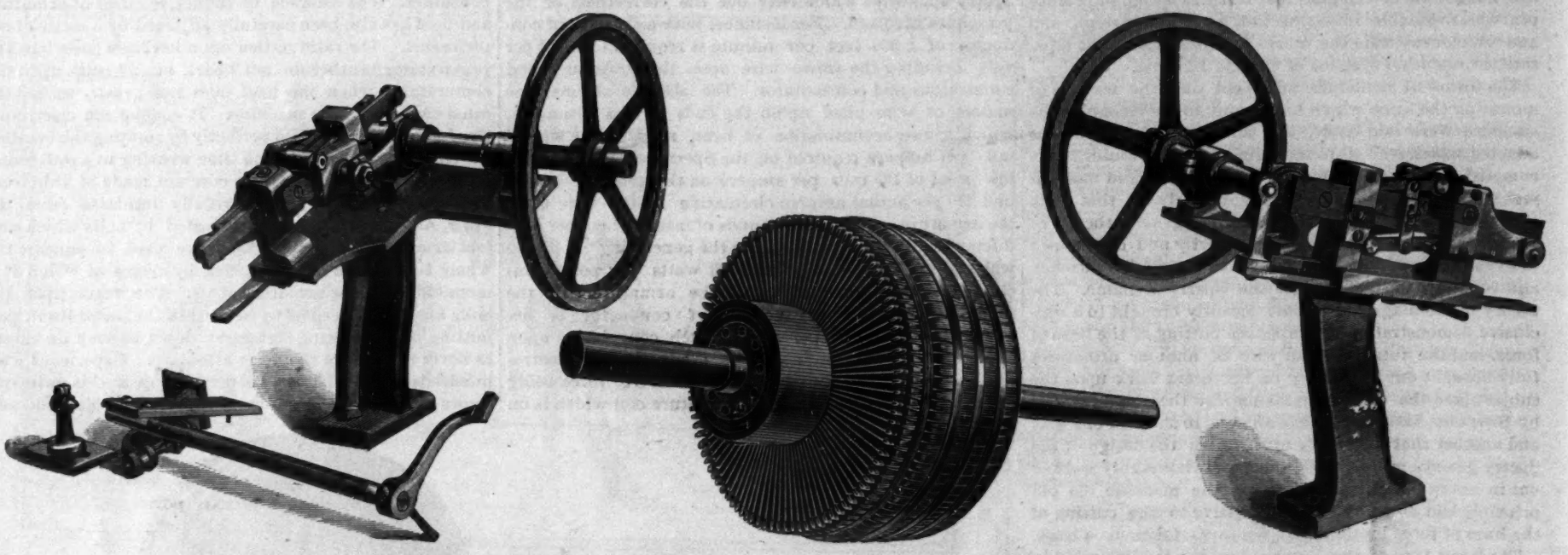
FIGS. 1, 2 AND 3.—THE SPERRY DYNAMO FOR ELECTRIC LIGHTING.

The armature is covered with a coating of non-combustible and indestructible substance, the basis of which is asbestos. This substance has a very high insulating property, and cannot become charred by any temporary overload. The commutator is of the usual form, mica being employed as insulation throughout. It is very durable and of simple construction.

The brushes and brush holder are of the simplest design, the latter being furnished with springs for adjusting the pressure of the brushes upon the commutator. As will readily be understood the rotation of these brushes through 90 degrees on a bi-polar machine sweeps through the entire range of electromotive force of the apparatus. In constant current apparatus, as the operated devices are turned off or on, these brushes are adjusted according to the electromotive force required on the exterior circuit.

The automatic regulator for the accomplishment of this result is one of the latest and best achievements of Mr. Sperry. In its conception it was designed to do away with all complications of the main circuit, wall-boxes, numerous sub-circuits or magnets upon the machine, which are liable to derangement and require more or less attention. In the Sperry machines the main lines pass directly to the main binding posts of the machine and do not pass through any magnets or other devices whatever. Complicated mechanical arrangements have also been supplanted entirely, there being an entire absence of gear wheels and like constructions. The principle of the operation of this new regulator is as follows: A small portion of the mechanical energy of the rotating shaft is employed to move or accomplish the mechanical

adjustment of the brushes about the commutator in response to the variations in the requirements in electromotive force of the exterior circuit. This mechanical energy is applied by a responsive device which is actuated from variations in the currents as they are being produced in the machine. To be more specific, a small magnetic mass is suspended in such a manner as to be affected by the magnetism of the pole piece of the machine. This device alone is found to work within certain narrow limits; the exterior circuit. A cam is therefore placed upon the regulator and moved in unison with the advance of the commutator brushes. The operating curve upon this cam has been accurately determined by experiment, and is found in most cases to be a section of a parabola, the mathematics of which are extremely interesting. The office of this cam is to control the application of an extra adjustment or helping force, which is gradually increased or diminished, and is applied to the rod upon positely faced ratchets, as will be seen in Figs. 1, 5 and 6. Two dogs of opposite phase operate in connection with these two ratchets. The dogs have a constant to-and-fro movement from the blocks upon which they are mounted by means of an eccentric upon a short shaft shown in Fig. 5. This shaft is rotated by pulley and belt from the end of the armature shaft, Fig, 1, or any other adjacent machinery. The dogs are pivoted loosely and are connected together by a link seen in Fig. 6; the lower one is provided

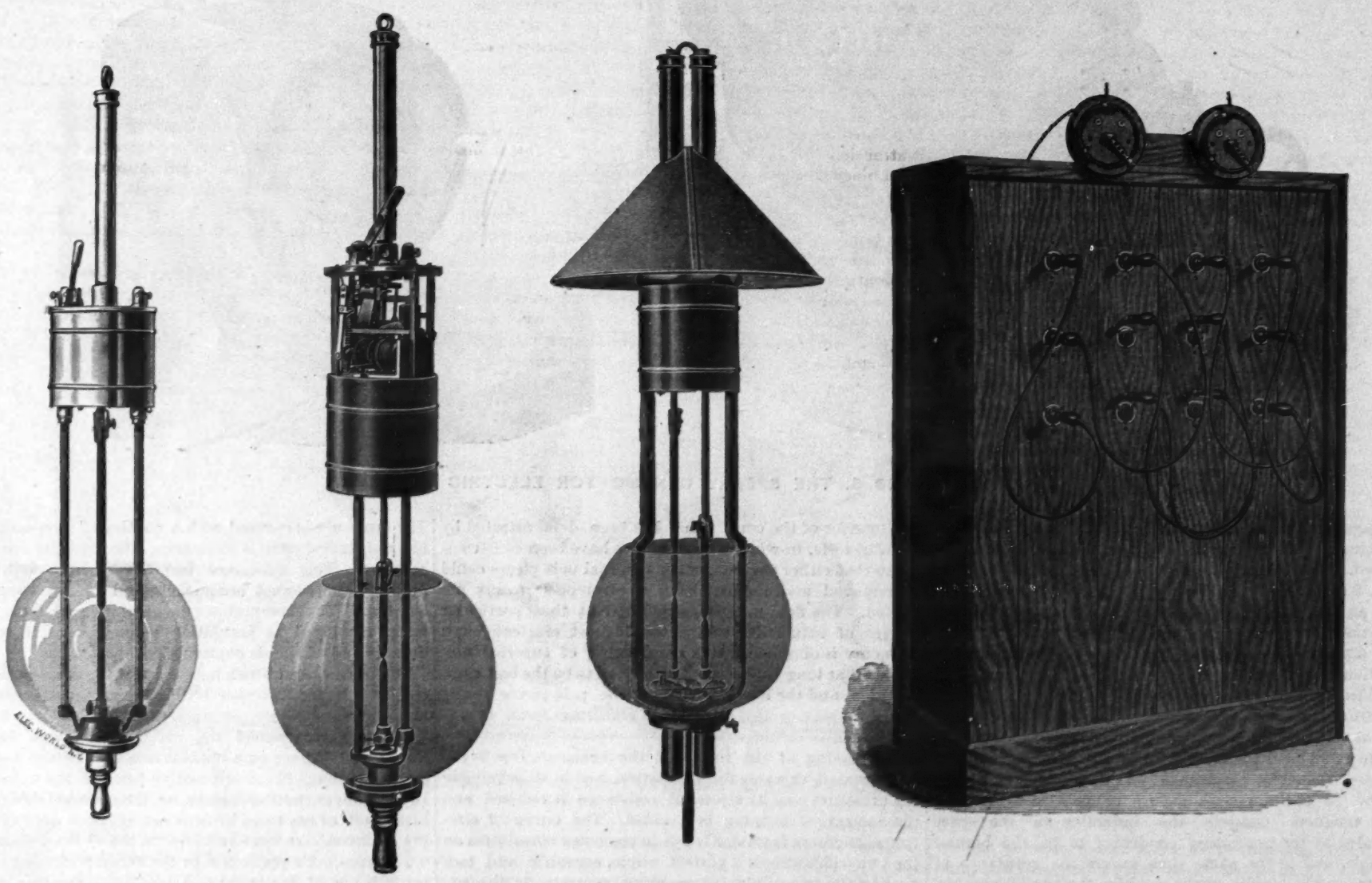


FIGS. 5, 4 AND 6.—THE SPERRY SYSTEM OF ELECTRIC LIGHTING: ARMATURE AND REGULATOR.

for instance, in a fifty light machine, from twenty to twenty-six of the arcs may be turned on and off without materially affecting the number of ampères and causing automatic regulation of the electromotive force in response to the requirements; but beyond this number the current will vary, running up in some cases to a hundred per cent. abnormal on a less number of lights, thereby endangering the insulation upon the armature conductor by overloading.

At this point a novel feature of the apparatus is brought which is mounted the vibrating mass. The amount of this extra adjustment exactly supplies the deficiency which exists at any time, resulting from the neutralizing effect of the magnetism of the armature upon the magnetism of the field helix; or, in other words, as the neutral point or magnetic axis of the armature advances under the pole piece and tends to neutralize its magnetism to a greater or lesser degree the deficiency is made up in mechanical adjustment of the helping spring, thereby making the rotative effort jointly applied to the with a roller which rolls to and fro upon a surface which is connected to a rod operated by the vibrating magnetic mass, and which extends back toward the field magnet, as will be seen, detached in the lower portion of Fig. 5. A downward projection upon this arm where it is secured to the rod mentioned serves for the attachment of the extra adjusting spring called into action by the cam and elbow crank lever visible in this illustration, and the office of which has just been described.

It will readily be seen that as the dogs are raised or low-



FIGS. 7, 8 9 AND 10.—THE SPERRY ARC LAMP AND SWITCH-BOARD.

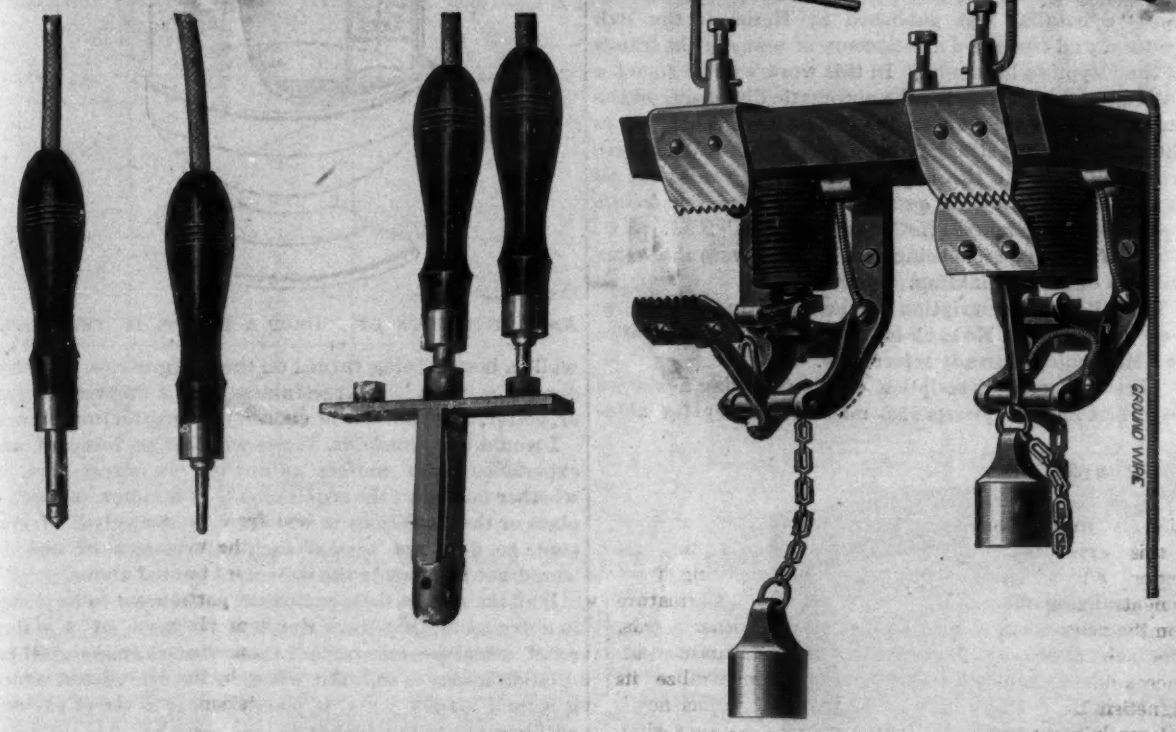
more actively into operation, which may be understood from the following: It will readily be seen that the radiant magnetism of the pole piece is a resultant of the magnetic effect of the armature acting in conjunction with that of the field helix. As the brushes are rotated and the magnetic axis of the armature changes its position, these pole pieces are varyingly affected as to intensity of magnetization, and therefore the vibrating magnetic mass will be affected, and will fail to apply the mechanical devices for adjusting the brushes at the proper time or to the proper extent to control the current accurately upon rod a constant and unvarying quantity, always ready to respond to the slightest variation in the requirements for energy upon the exterior circuit, no matter at what point upon the circuit such requirement exists. At the station of the Merchants' Arc Light and Power Company, in Chicago, the turning on, or off, of one lamp in 45 will cause an automatic adjustment of the brushes to be effected. This illustrates the extreme sensitiveness of the apparatus.

The mechanical motor is of the simplest construction, consisting of a bar furnished upon its two edges with opered from a central normal position they will engage their respective ratchets and move the ratchet-bar, and thereby rotate the brush yoke in either direction. An elastic connection is made between the extremity of the ratchet-bar and the brush yoke to prevent a concussive action and any bad effects which could result from the inertia of the brush yoke. It will also be noted that all mechanical joints can be tight and well made, and any attendant friction will not operate to retard the action of the regulator in the least, inasmuch as its movements are effected by mechanical energy which is merely called into action by the electrical.

One of the most ingenious features of this regulator consists in the simple arrangement of the line of movement of the dogs with reference to the line of movement of the ratchets. By observing Fig. 5 they will be seen to be at an angle to each other. This angle performs a most important function in the regulator, and one which will be appreciated by those who have given thought to the problem of a step-by-step regulator. It will be noticed that as either dog advances in its operative direction it at the same time approaches the ratchet, and recedes therefrom in its retraction. It will readily be seen that if a slight variation of current is required, the vibrating magnetic mass will move but slightly and the dogs will also be moved only to a slight extent, thereby dipping sufficiently to engage but a single tooth, perhaps, at the extreme end of the excursion, effecting an adjustment of the commutator brushes which is very small; whereas if a large variation of the current is required the vibration in the magnetic mass will be correspondingly great and the elevation and depression of the dogs will also be correspondingly great, even sufficient to allow the dog to engage its ratchet at the rear or extreme back end of its stroke. At this point it will, instead of engaging one tooth, engage six teeth, thereby moving the ratchet bar six times as far as in the first case, and effecting six times as much adjustment of the brushes. This, in particular, is a most desirable feature, inasmuch as in practice it allows motors to be operated from the same circuit as arc lamps, and as the load varies through wide limits, the regulator so operates as to instantaneously correct such variation even while it is taking place, so t hat the current and lights are held uniform and steady The wearing parts are made of hardened steel, the journals of gun metal, and other portions of the regulator of polished brass, and as a whole it is neat, simple and compact, and does not require a knowledge other than ordinary mechanical skill to comprehend and operate it. Recent tests show that the power required by the machine is in exact ratio to the number of lights in operation.

With this regulator all of the lights may be extinguished even to the last lamp without the slightest variation in the current. A majority, even to 75 per cent. of the total number of lights, may be extinguished at one time, and the regulator operates instantly to rectify the current strength and hold it uniform. A single spring, easily comprehended by a non-expert, serves to control and regulate the current of the machine and entire circuit. It is claimed that the promptness and instantaneous action of this regulator is absolute. When lights are extinguished, a corresponding amount of energy is automatically saved at the dynamo, which, consequently, uses less power, which means a saving in the coal bill and operating expenses.

The Sperry arc lamp contains features as novel, as to construction and operation, as the machine itself. Our illustrations, Figs. 7 and 8, show the single carbon lamp in two views, and Fig. 9 the double lamp. The mechanical portions have been worked out with great care, and its method of operation, which is new, has many advantages. It is beautiful in design and finish, and convenient and safe in handling, being supplied. when required, with a double-pole cut-out switch, by means of which the lamp is entirely removed from circuit; every part is automatic in operation. The carbon holders are of the most approved and convenient form, and the carbon-feeding rods are of hard-drawn bronze and of high conductivity. The lamp is provided with an automatic switch or cut-out to provide against any irregularity in feeding or inattention on the part of the trimmer. A novel feature in the lamp consists in the arrangement by which the carbon rod is made to move in both directions and entirely without the aid of clock-work or other complicated mechanism liable to derangement. Another feature of value consists in the fact that the guides to this rod, or rods, in the case of a double lamp, are so arranged as to partake of each motion of the rod, thereby doing away entirely with the friction that this rod ordinarily incurs which retards each of the minute movements required for its proper regulation. This retardation is entirely avoided by the construction adopted in the Sperry lamp, and as a result a steady and silent arc is obtained. Another result is that the regulation is effected by a much less percentage of the total current, and the lamp, not being a differential lamp, is not subjected to the disturbance due to slight changes constantly going on in the main current which causes the light to be unsteady and to flicker. The multi-carbon lamp is a new feature of the Sperry system. Lamps are constructed which burn respectively 8, 15, 22, 29, and 36 hours without attention. Upon the principle involved in this lamp any number of carbon rods can be operated from a single source.



FIGS. 11 AND 12.—THE SPERRY ELECTRIC LIGHT SYSTEM: DETAILS.

The Sperry switch-board, shown in Fig. 10, is neat in appearance and substantial in workmanship and is based upon a new universal plan by means of which any desired combination of circuits and dynamos can be secured at any time without shutting down, or causing an open circuit, or even a flash. This is accomplished by means of the main plug, and cross connecting plugs shown in Fig. 11. The switch-board is so arranged that no circuit connections are visible or contact possible on the exterior of the board, thereby reducing the danger to a minimum. Flexible cables are made specially for this purpose and are highly insulated. Upon the top of this board are mounted the ammeters, one for each circuit and also the lightning arresters, one for each circuit.

This last device, illustrated in Fig. 12, is automatic in its operation, taking off all static charges from the line and being always ready for action and requiring no readjusting of plates, putting in of insulations or unscrewing of any part whatsoever. The discharges are taken off of the lines instantaneously; the parts are durable and heavy and made for service. The instantaneous action has the advantage of not interfering with the consumer's light in the least. Constant discharges may be cared for without the customer even discovering their presence.

The system, as a whole, is complete in itself, and has been extensively adopted for both municipal and commercial lighting from central stations and isolated plants.

At the last meeting of the National Electric Light Association, held in Chicago, the new Sperry electric mining machine was exhibited for the first time. This machine has since been sent to the Paris Exposition, where it will be exhibited in operation. The machine is the latest of Mr. Sperry's many inventions. He was encouraged in perfecting it by Mr. A. L. Sweet, one of Chicago's most prominent coal men, who has in past years spent considerable money with other inventors in this line, but without practical result.

Though this machine was the first made, and naturally liable to some faults in construction, the results reached in actual work in the mines gave promise of a good future performance, which has since been verified by the second machine, which is illustrated in Fig. 13, and which gave the following results:

Number of tons undercut, one man and one helper, 10 hrs., 6 ft. vein	110 tons.
Depth undercut	4 ft.
Length of face	120 ft.
Horse-power required on surface	2.55
Cost of wires per running foot	$0.02
Distance from power to face	1,600 ft.
Number of blows per minute	200 to 250

The machine has been handled by a number of miners experienced with mining machines. They are loud in its praise and pronounce it the easiest machine to run they ever held, that it is almost entirely free from *recoil* and that each blow can be put in exactly where it is wanted. One great advantage and a unique feature is that no matter at what point in the stroke the pick is arrested by the work or face it is returned from that point instantly for the next blow and does not stand and push the miner back. Both the time and the power which would go into the remainder of the stroke are saved. This most important result is accomplished in the following manner:

A crank operates by means of a pitman to draw back or compress an extremely powerful spring. The crank is not attached rigidly to the power shaft, but is so arranged as to be automatically engaged with the power shaft only when the strain upon the crank is in opposition to the direction of rotation. When this strain is reversed at the back dead centre, and when it is such as to be coincident with the direction of rotation, then the crank is freed perfectly from the shaft and allows the projectile to be forced unimpeded forward. The pitman has a slot in it so that if the projectile is arrested in its work before the end of the stroke, the crank, owing to its momentum, will fly past the other dead centre and go as far up on its withdrawing stroke as the length of the pitman will admit, at which point it is instantly engaged with the rotating power shaft and compelled to make the remainder of its compression stroke without waiting or standing at that point an instant. When this compression stroke is completed at the back dead centre it is again automatically released and another powerful blow delivered. The blow of the pick is very great and is well adapted for undercutting in hard clay or coal. It stands the hardest usage which has been given it.

Another advantage of this machine is that the cost of installing one or more in a given mine is materially less than the cost of placing one or more air machines in the same mine. A small dynamo, costing $800, resting on the floor of the shop or engine-room, takes the place of the heavy air compressor costing $3,600, and requiring a heavy and expensive foundation.

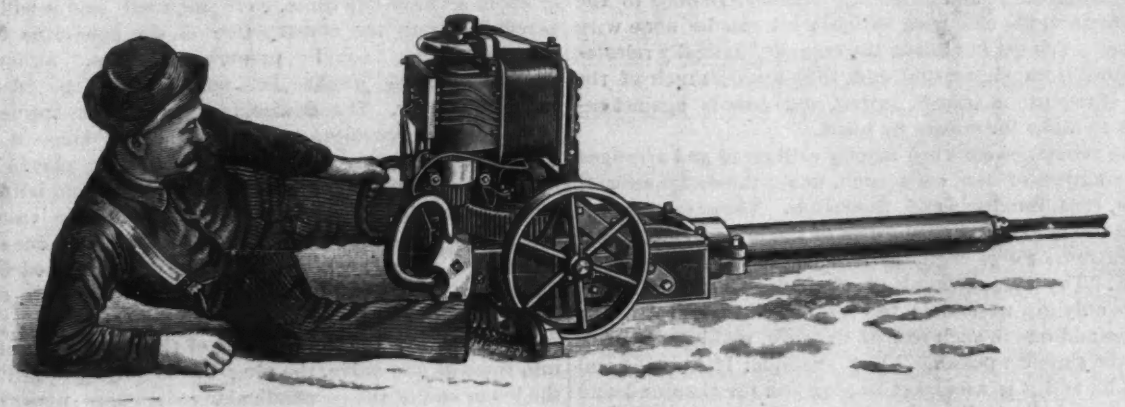


FIG. 13.—THE SPERRY ELECTRIC COAL DIGGER

Any ordinary engine can be used to run the dynamo, or water makes a desirable and economical power.

An engine to run ten machines with a capacity of 1,100 tons per 10 hours, costs $400. The wires are run in the entries in a few hours' time, and replace the expensive air pipes. There are no joints to be repaired or to be kept tight. Lights for the mine may be run from the same wires, and it has been suggested that the town be lighted by the same plant at evening, giving an additional revenue.

At a mine where a recent test was made, there was a compressor, 18 by 24 inches, making 80 revolutions per minute and using steam at 60 pounds to operate six Harrison machines, the average distance from face to foot of shaft being 600 feet; 79 h. p. was required, making over 13 h. p. on the surface necessary for each machine.

The following are some data furnished by Mr. Elmer A. Sperry, inventor of the machine, which will be of interest:

At dynamo on surface	2.55 h. p.
Watts " " "	1,579 watts.
" motor at face	1,532 watts.
Length of circuit	3,200 ft.
Furnished to drill	1.73 h. p.
Drop in transmission	2.25 volts.
Ampères (constant current)	20 amp.
Efficiency of motor	85 per cent
E. M. F.	80 volts.

It may be added that the Sperry Electric Mining Machine Company, organized to place the coal cutter on the market, of which Mr. A. L. Sweet is president, have a machine in operation at the Paris Exposition, as already intimated, in connection with the exhibit of the Sperry Electric Company.

The latter company's enterprise goes further than this, however, as it will be personally represented on the spot by Mr. Ernest E. Grepin, its treasurer, Mr. E. A. Sperry, its electrician, and Hon. Francis W. Parker, its counsellor and patent expert.

A New Wheatstone Bridge Set.

With the object of providing an instrument which, besides being portable, should be accurate and easy of manipulation, The E. S. Greeley & Co., of this city, have just brought out their new No. 3 Wheatstone bridge set which we illustrate on this page. The apparatus had its origin in the suggestion of Mr. C. E. Birdsall, of this city, formerly electrician for the Edison United Manufacturing Company, who devised the particular means of suspending and releasing the needle which is found in this instrument. The delicacy of action secured through the fibre suspension, in this instance, is so great as to obtain a strong deflection through 1.1 megohm with five cells of Leclanché

A NEW WHEATSTONE BRIDGE SET.

battery. The apparatus can be used without being removed from the case when it is not essential to level it, and when it is necessary to level it, it can be readily lifted out, as shown in the illustration, and leveled up with the screws provided for that purpose.

The revolving galvanometer and a variable and removable dampening and directing magnet conduce to the rapidity and the ease with which work can be done with the set. The act of closing the case automatically releases the fibre from all tension and thus avoids much of the risk of rupture in transportation, and guards against neglect to make the release by hand.

The resistance coils are strictly calibrated and arranged in four rows of ten coils each, under the designation of units, tens, hundreds and thousands. There are ten 100 and 1 000 ohm coils on each arm of the bridge, thus giving an extreme range of measurement from .01 to 1,111,000 ohms. The arrangement of the coils is such that six plugs only are needed in the set, one in each arm of the bridge and one in each row of the coils, making the reading the simplest possible. For example: If A = 100 and B = 10, and it is necessary to plug 5 in the thousand and 0 in the hundreds, 7 in the tens and 2 in the units row, the resistance measured is equal to 507.2, a method of reading that can hardly be exceeded in readiness and simplicity. The revolving galvanometer can, at any time, be so turned as to bring the needle to the zero line without altering the position of the case.

The Westinghouse Alternating Motor and Fan.

As announced some time ago, the Westinghouse Electric Company has been engaged in the construction of a series of alternating current motors, and the first of these to be placed before the public is a small motor and fan. Our illustration shows the motor of ¼ h. p., which is connected directly with the alternating circuit. The machine, it will be noted, is constructed on the general lines of the Tesla motor, already illustrated in these columns, and has neither commutator nor brushes. It, therefore, requires practically no attention whatever.

"Drop a Nickel in the Slot" Anticipated.

BY PROF. E. J. HOUSTON.

If King Solomon found it so difficult to be original, how much more so must it be now that so many inquiring minds have labored diligently since the days of Israel of old, to find out something brand new "under the sun."

So much has been recently written concerning anticipations of different patented ideas that some little hesitation is experienced in calling the attention of the readers of THE ELECTRICAL WORLD to a very curious instance of a recent invention that appears to have been known and used before the Christian era. I refer to an unquestioned anticipation of apparatus of the type of "Drop a nickel in the slot," etc. I trust that the novelty of the reference may warrant my calling attention to it.

Thos. Ewbank, in his "Hydraulics and Mechanics," published in New York, 1851, describes on pp. 386 and 387 a device referred to by Heron or Hiero in his "Spiritalia." The "Spiritalia" was published by Heron in the 16th century, and contained an exposure of many of the frauds of the Egyptian hierarchy. In this work will be found a description of a device for the automatic dispensing of the purifying water by the worshippers on their entrance to the temple. By a strange coincidence *five drachmæ* were required to operate the apparatus. "*In spondea hoc est in vasa sacrificii injecto quinque drachmorum numismate aqua ad inspergendum effluit.*"—"Spiritalia," XXI. *I. e.*, a coin of five drachmæ being cast into the vase the water will run out for sprinkling.

The following description of the apparatus referred to was published by Ewbank in 1851, in his "Hydraulics and Mechanics" already referred to.

"From Heron's description of the following figure we learn that heathen priests also made it (water for ablution) a source of revenue; the vessels containing lustral water not always being open for public use, free of charge, but closed and, like a child's money-box, provided with a slit at the top, through which a certain sum was to be put before the donor could receive any of the purifying contents. In the vase before us *five drachmæ* or about seventy-five cents, were required, and it will be perceived from the construction of the apparatus that no less sum could procure a drop, although as much more might be put in as the donor thought proper. The device is a very neat specimen of religious ingenuity, and the more so since it required no attending minister to keep it in play. We may judge of other apparatus belonging to the old temples by the talent displayed in this. A portion of the vase is removed in the figure to show the interior. Near one side is seen a cylindrical vessel. It is this only that contained water. A small tube attached to the bottom is continued through the side of the vase, where the liquid was discharged. The inner orifice of the tube was formed into the seat of a valve, the plug of which was fixed on the lower end of the perpendicular rod, whose upper end was connected by a bolt to the horizontal lever or vibrating beam. One end of this is spread out into a flat dish, and so arranged as to receive on its surface everything dropped through the slit. The lever turns on a pin or fulcrum very much like a pump handle, as represented. The operation will now be understood. As the weight of the rod kept the valve closed while nothing rested on the broad end of the lever, so no liquid could escape; but if a number of coins of sufficient weight were dropped through the slit upon the end of the lever, the valve would then be opened and a portion of the liquid escape. The quantity flowing out would, however, be very small, not only from the contracted bore of the tube, but from the fact that the valve would be open only for a moment; for as the lever became inclined from its horizontal position the pieces of money would slide off into the mass accumulated below, and the efflux would as quickly be stopped; the apparatus would then be ready to supply the next customer on the same terms."

Waterproof and Fireproof Motors.

To the Editor of The Electrical World:

SIR: I notice in your issue of May 25, an article headed, "The Kind of Dynamo Wanted," by Mr. H. F. Watts.

Mr. Watts remarks that the Sprague and Thomson-Houston companies have produced motors which they claim to be waterproof, and which will do their work

AN ANTICIPATION OF "DROP A NICKEL IN THE SLOT."

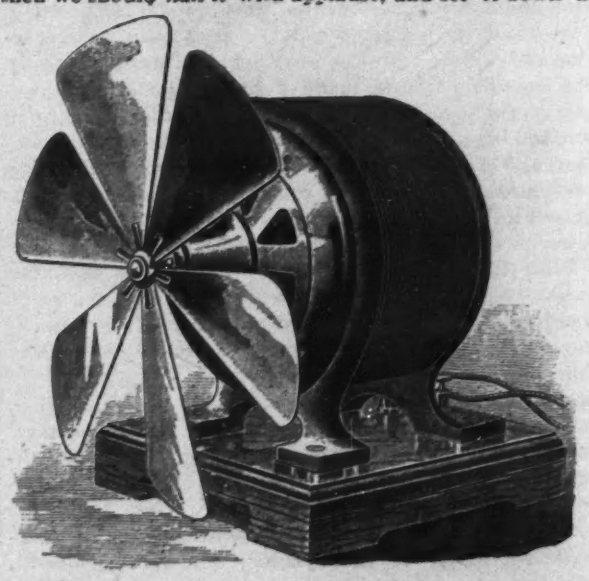
while a hose is being turned on the commutator, and have done this in evident forgetfulness that a fireproof motor, or, better, a dynamo, is of enormously greater importance.

I would like to ask Mr. Watts whether he has had any experience with motors as applied to street cars, or whether he knows the requirements of a motor in such a place or the conditions to which it is subjected? I conclude he does not possess such information, or else he would not have made the statement quoted above.

If all the motors these companies make were to be placed in a dry room, then there would be no need of a waterproof armature, any further than what ordinary good insulation makes it so. But when an electric motor, which is wound for 500 volts, is placed under a street car and within eight or ten inches of the ground, it is subjected to conditions which Mr. Watts evidently fails to comprehend or has not thought of.

Past experience has shown that motors for this purpose must be waterproof, as they are subjected to the splash and spatter of mud and water and are often required to pass through pools of water which entirely submerge a portion of the apparatus. Surely the companies referred to have made no mistake in bending their efforts to produce such a machine.

Of course any one is ready to admit that a fireproof motor would be a grand thing; but I would like to ask whether a motor which is fireproof within itself must not first be waterproof? Aside from overload, is it not dampness which causes the adjacent coils of an armature to short circuit in a great many cases? If science is not sufficiently developed to give us a fireproof armature, but by its untiring efforts has produced a thoroughly waterproof one, then we should hail it with applause, and set it down as



WESTINGHOUSE ALTERNATING MOTOR AND FAN.

one more valuable step in the direction of the perfection of electrical machinery.

ST. JOSEPH, MO. J. H. BICKFORD.

Charging Potential of Storage Batteries.

To the Editor of The Electrical World:

SIR: Will you kindly submit the following question to your readers: A dynamo running at 200 volts is connected with accumulators about a mile away. The E. M. F. of dynamo measured near accumulators is only 80 volts. The E. M. F. of the accumulators in circuit is 100 volts measured near them. Will the dynamo charge the accumulators, and why? READER.

The Inherent Defects of Lead Secondary Batteries.*

BY DR. LOUIS DUNCAN AND H. WIEGAND.

The following must be regarded as a preliminary announcement of experiments which are not yet finished. Our subsequent work may modify even the few deductions which we have felt authorized to draw.

Since the year 1881, when the inventions of Faure gave such an impetus to the industrial development of lead secondary batteries, their commercial history has been marked by numerous and disastrous failures, while at the same time there has been a steady improvement in their construction and performance until at present they have reached a stage which makes them for some purposes a commercial success. At the same time there remain in the best batteries a number of defects which prevent their taking the place in the practical development of electricity which rightfully belongs to them. The action of the secondary battery is quite well understood. In the Faure type a support plate, usually made of lead or an alloy of lead, has mechanically applied to it some salt of lead (minium or litharge). A number of such plates are placed in dilute sulphuric acid, the alternate plates being connected respectively to the + and — poles of some source of electricity, and a current is sent between them. The result is a

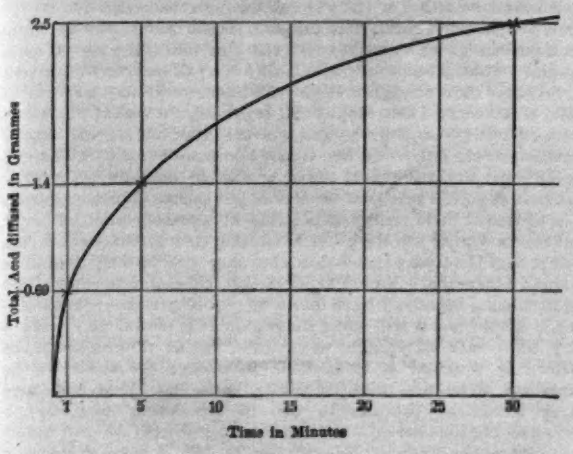


Fig. 1.

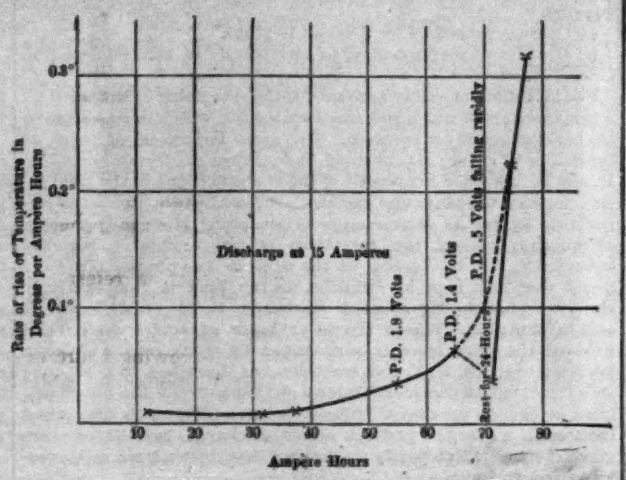


Fig. 2.

FIGS. 1 AND 2.—THE INHERENT DEFECTS OF LEAD STORAGE BATTERIES.

reduction on the positive plates (the plates through which the current enters) to PbO_2, on the negative plate to spongy lead. After this "formation" the action, roughly speaking, consists in a reduction of both peroxide and spongy lead to sulphate of lead on discharge, while on charging they are reduced again to their original composition. We find that in the process of charge and discharge there is a loss of energy varying from 15 to 40 per cent. within the practical limits of discharge rate. If we calculate the theoretical storage capacity of a given weight of lead and peroxide we will find that the plates of even the best modern batteries weigh for the same capacity ten times as much as would those of a theoretically perfect cell. We will find, too, that there is a constant depreciation especially of the peroxide plates, the rate of depreciation increasing with the rate of discharge, and in general depending partly on the way in which the cell is treated, partly on its construction.

The principal defects of the modern lead secondary battery are (1) the comparatively small storage capacity, (2) the loss of energy, (3 the depreciation, (4) the low discharge rate necessitated by considerations of efficiency and depreciation. It was especially the question of the loss of energy in the battery that we wished first to investigate. There are two factors which determine the extent of this loss: In the first place, the number of ampère-hours obtained on the discharge of the cell is less than the number put in; and in the second place, the P. D. at the terminals is greater during charge than during discharge. This loss of energy exhibits itself in two ways—in the generation of heat, and in chemical actions which are not reversed on discharge. It is well known that after a cell has been in use for some time, especially if it be submitted to rapid charge and discharge, there will be found in the bottom of the containing vessel a white, powdery deposit, a sulphate of lead which has been formed from the active material of the plates, and which has not been afterwards reversed. Again, when the cell is charged we find bubbles of gas escaping from the plates during almost the whole of the charge, the escape becoming quite violent towards the last. The escape is at first principally from the positive plate, but afterwards it is from both plates. This escape represents, of course, a loss of energy due to the electrolysis of the dilute acid in the cell, the products being free hydrogen and oxygen.

Let us consider what takes place during the charge and discharge of a cell. Supposing the cell to have been discharged until its P. D. has dropped to 1.8 volts, on beginning to charge the P. D. increases until it reaches a value of about 2.1 volts—at a normal charge rate—then increases very slowly during a considerable portion of the charge, then increases faster until it reaches a value of from 2.4 to 2.5 volts, when the cell is "boiling." The chemical action results principally in the reduction of the sulphate of lead on the two plates to peroxide and spongy lead respectively. The greater the charge rate the higher will be the P. D., and the sooner will the cell begin to boil, and the greater will be the loss.

On discharge the P. D. drops to from 2 to 1.95 volts for normal discharge rate, where it remains during the greater part of the discharge, there being a gradual fall during the latter part to 1.8 volts, when the discharge should cease. If a high discharge rate be employed, there is a decrease in the capacity and efficiency, and a more rapid depreciation. If the discharge be continued after the P. D. has dropped below 1.8 volts, there will be a formation of white sulphate on the plates, there will be a loss of energy, as will be shown, and there will be a rapid depreciation of the cell. The result of the discharge is a formation of sulphate of lead on both positive and negative plates. If we test the specific gravity of the solution at different times we will find that the solution has a maximum strength—say 1.200—when fully charged, with a minimum on discharge—say 1.150,—the sulphating of the lead decreasing the strength of the solution. The number of ampère hours obtained on discharge is less than the number put in by an amount depending on the construction of the cell and the conditions of charge and discharge. There is a further apparent loss of energy in the fact that the electromotive force on discharge is less than that during charge.

Our first experiment was made to determine, if possible, whether part of this difference of E. M. F. was not due to the fact that the strength of the solution *in the plugs* varied, it being stronger during charge than during discharge. During discharge the sulphuric acid in the plugs has its strength decreased by the sulphating of the lead or peroxide. This weakening continues until the diffusion of the stronger acid in the cell produces a condition of equilibrium. It is known that the electromotive force of a cell varies with the strength of the solution, being higher as the strength increases. Gladstone and Tribe have found that when the acid is very weak the chemical action is changed, the result on a positive plate of sheet lead being the formation of streaks of a mixture of yellow and puce-colored oxides, while on other parts a white substance is formed, which easily is detached, falling in clouds into the liquid. This white substance is probably a basic sulphate of lead. When this action takes place the corrosion of the plate is more than doubled. So if the diffusion in the plug is slow, it may very well happen that there would be a great difference of density during charge and discharge, causing a difference in electromotive force and a formation on discharge of chemical compounds which are not afterwards reduced. A rapid discharge rate would tend to greatly weaken the acid, and, therefore, decrease the efficiency and hasten the corrosion of the positive plate. To find the rate of diffusion we soaked the plates or single plugs to be experimented on in acid of a sp. gr. of 1.175, and then placed them in vessels of distilled water letting them remain for different intervals of time, and determining the amount of acid diffused out into the water. To give some idea of the magnitude of the result, I select the following figures from a number of experiments. The plates used weighed about a pound and a half (.7 kilos.), and were of the grid type:

Positive plate, charged.		Positive plate, discharged.
Time in water.	Acid diffused.	Acid diffused.
1 min.	.695 grms.	.29 grms.
5 "	1.41 "	.60 "
30 "	2.50 "	1.43 "
Negative plate, charged.		**Negative plate, discharged.**
	Acid diffused.	Acid diffused.
1 min.	.86 grms.	.317 grms.
5 "	1.42 "	.700 "
30 "	3.05 "	1.35 "

The curve shown in Fig. 1 gives the diffusion from a discharged positive plate.

The total amount of acid in the charged positive plates was (25 grms of 1.175) about 5 grms.; so it will be seen that the rate of diffusion of the acid in the interior of the plugs is slow, for after 30 minutes, when half of the acid remains in the plug, the rate of diffusion has decreased from about .7 gramme for the first minute to about .025 gramme per minute. While this is hardly the condition of affairs in actual practice, where the rate at which the acid is being added or abstracted varies in different parts of the plug, yet it gives some idea of the magnitude of the quantity. It should be noted that the rate of diffusion is materially the same for positive and negative plates, but that the rate for a discharged is considerably less than that for a charged plate. Keeping these facts in mind, let us pass to the phenomena of charge and discharge.

To investigate the loss of energy from heating, we placed the cell to be experimented on in a wooden box lined with a layer of felt about an inch thick. There was a top for the box, also lined with felt, and through it passed the rod of a stirring paddle and the stem of a thermometer. Experiment showed that the loss of temperature in this arrangement was for a

Diff. betw. air and box.	Degrees loss per Degree diff. per hour.
7.2	.12°
5.1	.10
4.2	1.095

In the experiments we tried as nearly as possible to keep the air and cell at the same temperature, and the correction for radiation could usually be neglected. The cell was charged and discharged under a number of conditions, and the rise of temperature and other data were observed. The losses of energy that occur must, as has been stated, exhibit themselves in heat or in chemical changes which are not reversed. The cell was of the grid type, with 4 positive and 5 negative plates. The weights were:

Total weight	25 lbs., 3 oz.
Weight of plates	17 " 8 "
" " vessel	1 lb., 3 "
" " solution	6 lbs., 8 "

This gives a heat capacity for the cell such that the energy lost is approximately 3.2 watt-hours per degree rise of temperature.

The cell was first charged at 5 ampères until over 150 ampère hours had been put in; both positive and negative plates were boiling freely. The discharge was at a rate of about 15 ampères. Some of the particulars of the discharge are:

Amp. hours. discharge.	Rate of rise of temp. per amp. hour.	Total rise of temp.	$C^2 R$.
10	.012	....	....
20	.01	....	....
30	.008	....	....
40	.015	....	....
50	.03	....	....
60 p. d. falling.	.05	2.03	11 watts.
70	.12	....	....
77	.30	3.75	13 watts.

In this case the discharge was carried far beyond the limit of economical discharge. It will be seen that the loss is greater as the discharge continues, increasing slowly until the E. M. F. begins to drop, when it rises very rapidly.

After this discharge the cell was charged at a rate of 10 ampères.

Amp.-hrs.	Rate of rise.	Total rise.	$C^2 R$.
20	.04	....	....
40	.04	....	....
60	.05	....	....
80	.08	4.7	8
100	.166	8.9	....
120	.20	11.5	12

The cell thus charged was discharged at a rate of about 20 ampères. The rate of rise of temperature was very much as in the case of the discharge at 15 ampères. The total rise, with the P. D. down to 1.7 volts, 60 ampères having been taken out, was 1°.1; on further discharge down to .7 volt, taking about 20 ampère-hours more from the cell, the rise was 4°.1. This again shows that the loss increases as the P. D. falls.

The next charge was at 20 ampères. The rate of rise of temperatures is given by the curve. The total rise was 30°.7. The rise for 100 ampère hours was 11°.5. The corresponding values of $C^2 R$ were 34 watts and 20 watts.

The effect of a rest is shown on the portion of the curve between 105 and 120 ampères, where a 16-hour rest gives a considerable reduction in the rate of temperature increase. The maximum rate is about .3 degrees per ampère-hour.

The cell thus charged was discharged at a rate of 30 ampères. The discharge was divided into periods of 20 minutes, with periods of equal length between, the object being to determine, if possible, whether there is a local action in the mass of the plug due to the different chemical condition of the different parts of the plug, which would especially be the case if the charge or discharge were rapid. As in the previous case of discharge, the rise of temperature was slow, there being a gain of but 1°.3 for a discharge of 40 ampère-hours, the heating effect of the current in that time being 12 watts, equivalent to almost 4°. For the first three periods there was little if any rise during the time of repose; for the fourth period there was a rise of about .1°, or .3 watt hours. During the fifth period the E. M. F. began to fall, and during repose after it the temperature rose .15°. The sixth discharge period was with the same current, but at a greatly reduced P. D. and external resistance. It lasted 12 minutes;

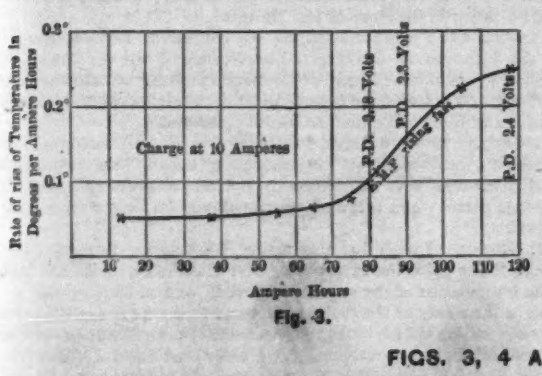


Fig. 3.

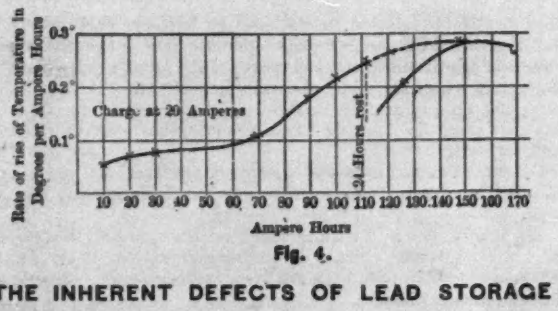


Fig. 4.

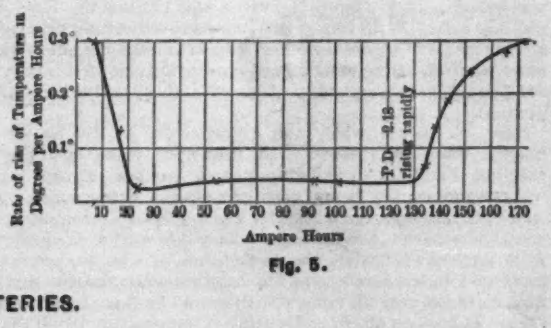


Fig. 5.

FIGS. 3, 4 AND 5.—THE INHERENT DEFECTS OF LEAD STORAGE BATTERIES.

after it the temperature rose .5°, corresponding to 1.5 watt hours. The output of this discharge was 44 ampère hours at a normal P. D.; 11 at a low P. D. The total rise of temperature was 3°.5; the value of $C^2 R$ was 16 watts.

The cell was then charged with 70 ampère-hours at 30 ampères, the same periods of repose being allowed. There was a definite rise during the periods of repose amounting on the average to about 2°; after the first period the rise was but .1°, the others slightly over .2. The details of the charge were:

Amp.-hrs.	Rise in temp.	Rate.	$C^2 R$.
15	1.	.067	4.5
40	4.4	.18	11.5
70	13.1	.29	20.5

The details of the discharge at 30 were:

Amp.-hrs.	Rise.	Rate.	$C^2 R$.
10	.14	.014	3.2
25	.62	.032	7.7
35	1.02	.04	10.7
45	1.62	.06	13.7
54 P. D. fell.	2.62	.11	16.5

The rise during the periods of rest for this discharge was at first small, but afterwards something over .2°.

The next charge was at a rate of 40 ampères. The following are the figures:

Amp.-hrs.	Rise of temp.	Rate.	$C^2 R$.
20	1.5	.075	8.
42	3.9	.11	15.
63	8.0	.20	22.
80	13.2	.3	28.
97	18.65	.32	34.
....	Rest.	....	....
106	21.35	.30	30.75

The rise during periods of repose was .1° for the first period, .7° for the second, and decreased as the charge increased until it reached a value of about .2°.

*A paper read before the American Institute of Electrical Engineers, New York, May 22, 1889.

The discharge corresponding to this charge was also at 10 ampères, and was divided into periods as before.

Amp.-hrs.	Temp.	Rate.	C^2 R.
14	.46	.033	5.
28	1.16	.05	11.
42	2.24	.077	17.

Whether the rise in temperature during the periods of rest is due to the heat of the plates being diffused into the liquid, or is due to a local action in the plugs, is difficult to determine. If it were due to local action we would expect a greater rise during the first periods of the charging experiments, and this is what we find. If it were due simply to diffusion of heat, we should have approximately the same effect at corresponding periods of charge and discharge, the rates being the same, but we see that it is greater during some of the charge than corresponding discharge periods, and it is not uniform even during charge and discharge, being sometimes greater when the resistance of the cell is less. Some of the rise is undoubtedly due to the diffusion of heat from the plates, but it seems certain that a part of the effect is due to local action.

Our next experiments were with negative and positive plates which were in different conditions of charge and discharge. At first a cell was made up of fully charged negative plates, with positives from which 45 ampère-hours had been taken, and it was discharged in the calorimeter at a rate of 10 ampères.

Amp.-hrs.	Rise.	Rate.	C^2 R.
4.2	.05°	.012°	.5
17.5	.20	.011	1.8
Rest.			
35.8	.45	.009	2.6
49.1	.85	.03	4.0
66.1 P. D. fell.	3.05	.13	6.0

Next a cell with fully charged positives and negatives, from which 47.5 ampère-hours had been taken, was discharged at a rate of 5 ampères.

Amp.-hrs.	Rise.	Rate.	C^2 R.
10.	−.1	−.01	.5
15.5	−.15	−.01	.75
20.5	−.20	−.01	1.00
23.	−.20	.00	.1
29.	−.20	.00	1.4
34.	−.20		1.65
39.	−.17	+.008	1.9
41.5	+.05	+.08	2.05
Rest.			
47.5	+.28	+.04	2.45
49.5 P. D. fell.	+.50	+.11	2.55
Cell short-circuited: very small current			
1 hour.	+.80		
6 hours.	+3.00		
11 hours.	+ 5.2		
22 hours.	+11.2		
23 hours.	+11.8		

After this exhaustive discharge the cell was charged at five ampères, attempts at discharge being made at intervals. At first the P. D. fell at once on closing the discharge circuit, but after about 16 ampère-hours had been put in a discharge of five ampères for eight minutes was obtained. The temperature, which had been rising quite fast, began to rise slowly at this point, the rates being given by the curve.

The cell boiled with a charge of 117 ampère-hours, when the total rise of temperature was 9°.6 with C^2 R = 7 watts. For a charge of 160 ampère-hours the rise was 17°.3 with C R = 9 watts.

Another discharge of negative plates which had 58 ampère hours taken out gave:

Amp.-hrs.	Rise.	Rate.	C^2 R.
9	0°	0°	.5
22.2	.39	.019	2.0
31.0 P. D. fell.	.61	.026	2.5
34.2	.90	.09	2.7

This gave the total capacity of the negative plates at a discharge rate of 5 ampères as about 90 ampère-hours; the previous experiment gave 93. The capacity of the positive plates was 94 ampère-hours. It was noticed in these experiments that when a partly run-down negative was used, the fall of potential after a value of 1.5 volts was reached, was very rapid. From 1.3 to .5 volts took less than a minute, while in another minute the value had reached .25 volt, and it was soon only a few hundredths of a volt. With the discharged positive, on the contrary, the fall was slow. After a value of 1.35 was reached, the fall in a half hour was only to 1.04, and in four hours it was .66 volts. After several hours short circuit, when the value had reached a few hundredths, the circuit was broken. In five hours the value was 1.65, and the next day it was 2.02 volts. With some plates made by depositing thin layers of spongy lead and peroxide on lead support plates, the effect was still more marked. Here the P. D. of a negative plate fell from a value of 1.8 to .05 in ten seconds; while with the positive the fall was gradual.

Now let us see what our experiments, as far as we have carried them out, show. In the first place the loss that exhibits itself in heating increases as the charge or discharge goes on, not being very great in the latter operation until the P. D. has begun to fall. The loss is greater during charge than during discharge. For instance, take a discharge at 15 ampères, the P. D. begins to fall when 60 ampère-hours have been taken out. The total rise in temperature is 2.03 degrees, while the rise due to the heating of the current alone (C^2 R) should be 3°.4. In other words, there has been an absolute lowering of temperature by all the other actions outside of the Joule effect. Taking a charge at 10 ampères the rise for a charge of 100 ampère-hours was 8°.9, with a loss due to the Joule effect corresponding to 3°, a difference of 5°.9. The difference in the losses for charge and discharge—neglecting C^2 R—is about 5°.3. For a charge of 120 ampère-hours at 10 ampères the rise was 11°.15.

We will find the same results in all of the other records, there being sometimes an absolute fall of temperature on discharge. This is without doubt largely due to the fact that the acid is strengthened on charge, weakened on discharge. In changing from a specific gravity of 1.14 to 1.18, the evolution of heat is such as to raise the temperature of the solution about 3°.2; there will be a corresponding cooling effect on discharge.

To the above charge at 10 ampères there was a discharge at 20 ampères, which gave a total of 84 ampère hours, of which 60 were at normal P. D.; the rise for normal P. D. was 2°.0.; total rise, 4°.7. C^2 R = 12.1 for the 60 ampère-hours, corresponding to 3°.8; the total value of C^2 R for the 84 ampère-hours was 15.1, corresponding to 4°.7. The total heat loss in the process of charge and discharge was 11.15 + 4.7 = 16°.2, or about 51 watts. The total loss obtained from taking the difference between charge and discharge energies calculated from the ampère-hours and P. D. was 98 watts, more than half of which appeared as heat. Of the 51 watts which appeared as heat, 27 were due to the Joule effect, 34 to other causes. We believe that part of this loss—a very small part—is due to local action between the positive material and the support plate. Another part is due to local currents in the plugs themselves. When the plate is charging or discharging, the distribution of current in the plug is not uniform, but it is denser at the surface than in the interior. After a while the plug is not uniform in its chemical composition, and there are doubtless eddy currents in such a way as to tend to bring the plug to uniformity of chemical condition. These will be more important as the current rate increases. The last part of the charge of the cell consists largely in the electrolysis of the dilute acid with a liberation of oxygen and hydrogen. It is known that heat is generated in this process,* the amount depending on the density of the acid and the nature of the electrodes. M. Gramme in some experiments on the electrolysis of water, only utilized 50 per cent. of the energy expended in producing electrolysis, the remainder being lost. In our own case, when the charge has reached such a point that the reduction of the plates is complete, the principal action is the electrolysis of the solution into H and O. If the total P.D. is 2.5 volts, and if the energy of combination of oxygen and hydrogen corresponds to about 1.5 volts, we may expect of the energy of 2.5 watt hours, corresponding to a charge of 1 ampère-hour, 1 watt-hour to appear as heat. If we look at the tables we will see that the rate of rise of temperature for overcharge is in the neighborhood of .3° per hour per ampère, and this corresponds to about 1 watt, as we would expect. As this action (shown by the evolution of gas from the plates) continues through the whole of the charge and part of the discharge (doubtless due to local action in the latter case), we will always have *some* corresponding rise of temperature, although it will not reach its full value until the cell is boiling.

The rise of temperature, then, is due to:

(1) The Joule effect, 27 out of 51 in this case.

(2) Currents caused by local action between active material and support.

(3) Current caused by local action in plugs.

(4) Heat losses corresponding to electrolysis of solution into free O. and H.

The last three probably account for the remaining 34 watts.

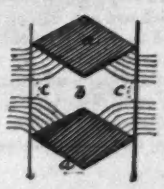
But there are 47 watts left unaccounted for, which must be due to chemical changes not reversed. The most important of these, as far as loss of energy is concerned, is doubtless the formation of free H. and O. Another component of the 47 watts is due to the local action between the plugs and support. But we believe the most important, as far as deterioration is concerned, is in the corrosion of the support and the formation of irreversible compounds caused by the weakening of the acid in the plugs. We have found that the rate of diffusion in the plug is comparatively slow, so that during a rapid discharge there must be weak acid in the plug. Where the outer layer of active material is reduced, the inner layer is surrounded by weak acid, causing a lowering of the E. M. F. and corrosion, as described by Gladstone and Tribe, with a considerable local action between the outer and inner layers. As the rate of diffusion is less with a partly discharged than with a charged plate, a heavy discharge rate has a more marked effect with a partly discharged than with a fresh cell, as experience has shown.

These are, we believe, the principal sources of loss in a lead secondary battery, and the depreciation can be mainly charged to them. The expansion and contraction of the plugs in a grid plate is another source of trouble, and cannot be avoided. Our own experience has been that the losses are less with plane plates, coated with thin layers of active material, than with plates made of the grid form. Under any circumstances, an increase of surface for a given current rate is to be desired, as it lengthens the time of charge before the violent boiling occurs. A plane plate gives a uniform distribution of current, and, therefore, very little local action.

The Inherent Defects in Lead Storage Batteries.

We give below the discussion on Dr. Louis Duncan's and Mr. H. Wiegand's Institute paper, Prof. Elihu Thomson, presiding.

The PRESIDENT: I am sure we have all listened with great attention to this paper of Dr. Duncan's, as it brings forth a number of points which I do not think have been given the prominence which



ACTION OF THE ELECTROLYTE ON THE PLUGS OF ACTIVE MATERIAL.

they deserve, in relation to the storage battery, particularly the point of the existence of eddy currents due to the difference of chemical conditions of different parts of the plug; it also fixes the losses just where we would naturally expect to find them. There is one point I might ask information on. I understood the Doctor to say that after the charging was completed, there was a continual and rather large loss.

Dr. DUNCAN: Not after the charge is completed and the current shut off, but when the action is simply the electrolysis of the solution.

The PRESIDENT: I wish to offer one more remark, that possibly part of the loss may come in in the recombination of the solution of the ozonized oxygen with the free hydrogen and producing heat in the solution itself.

Prof. ROBERTS: I would ask if it was a constant rate of charge or if the charge gradually tapered off as the battery filled. I was not quite sure when Dr. Duncan spoke of plates that merely had a face action instead of plugs, whether they heated comparatively more or less than when there was plug action.

The PRESIDENT: I understand the inquiry to be whether there was more or less energy in the flat plate with the coating of active material laid over it than when the plugs were used? Is that it?

Prof. ROBERTS: Yes, sir.

Dr. DUNCAN: Well, the discharge and charge rates were always the same. As for the flat plates, I experimented on some plates which were made by depositing peroxide on plain sheets of lead from a caustic solution of litharge. In that case with a very thin layer, about a quarter of an ounce to the square foot of spongy lead and a corresponding amount of peroxide, the efficiency of the cell at a discharge rate which corresponded to that of the Julien cell, 25 ampères for a surface of about 7 feet, I think, was about 90 per cent. But, of course, in that case the proportion of active material to total weight was very great. There was only a very thin layer and the distribution of chemical action was uniform and there was comparatively very little loss. A part of that 90 per cent. could be accounted for by the electrolysis of water.

As for the heating effect due to the electrolysis, I think Professor Thomson's suggestion is a very good one, but we did not attempt to find out what that heating effect was due to. It ought to be in about the same proportion; if the electromotive force is 2½ volts, then for one ampére hour the loss is 2½ watt hours. If the electrolysis itself takes up 1½ of the 2½ volts, then the other actions, whatever they might be, should give a loss of one watt hour to 1½ watt hour for electrolysis. I simply put that 1½ down to loss from heating effect. But it is probably due to that cause that Professor Thomson gave.

Prof. ROBERTS: I asked that because of my impression from some experiments, though I did not make enough of them to be sure it was the fact, relating to the effect of the electromotive force rising after a few moments of rest. I happened at one time to have some storage batteries under my care, and the lights would get very bad at night, and the next morning it was a very nice thing, when the consumer complained, to turn the light on and say, "We have not charged your battery since last night." (Laughter.)

Mr. TOWNSEND WOLCOTT: I understand Dr. Duncan to say that the chemical action of the plug begins at the surface of the plate.

Dr. DUNCAN: Yes, I think it does.

Mr. WOLCOTT: As far as my experience goes, in the ordinary form of plug (Fig.), the grid *a* is a much better conductor than the active material, *b*. A new cell starts to form first right along the edges of the plate and the last place that it is formed is in the middle on the outside at *c*. Then it seems that as that begins to form it becomes a still better conductor, so that it increases that action. The thing is to get that middle formed up as good as the other part. I think that is where a good deal of loss comes in, from the difference between the amount of current the storage battery ought to give, and what it does give.

Dr. DUNCAN: That probably is the action that does take place.

The PRESIDENT: On the point just mentioned it would, of course, appear that that plug is not as good a conductor as it ought to be. If it were simply a very good conductor, then we would have an evening up at once, even though that evening might not take place from actual condition of the current through the plug.

Mr. WOLCOTT: I think that emphasizes the point that Dr. Duncan mentions there about a very thin film uniformly spread on a flat plate—that the action is equal all over. Of course, the current would come right straight out there. There would be no spots.

Mr. MAILLOUX: There is one point regarding the rate at which batteries are charged and discharged which I think has a great deal of influence on the efficiency, and it also has some interest industrially. In order to get the most out of a storage battery we want to charge it at such a rate that we should get the maximum efficiency so as to lose as little energy as possible in electrolysis, or, at least, electrolytic work. On the other hand, the circumstances of its use dictate that the time expended in charging the battery should be as small as possible. Now, I think that it is possible to satisfy both requirements, because I have found by experience that when a battery is discharged it will stand during the first period of charge a very high rate of charge without evolution of gas, and if the battery is watched it is possible to charge the battery in the minimum time, and also, probably, with as good efficiency as it would be possible to use in any other way, by always keeping the current at such a rate that it will be just below the point where it causes the evolution of gas. I have in this way made it a practice to begin charging batteries whose normal rate of charge would be say 15 ampères, with as high a current as 50 ampères, which could be kept up for an hour or two. Then it would have to be cut down to perhaps 30, which could be kept up for another hour; then 20, then 15, then perhaps to 10, then to 5, and sometimes I would finish with as low as 3. Now, in that way the battery was never allowed to evolve gas, and I think that that is the best way in which to treat the battery, for the simple reason that it gives the energy as fast as the receptive matter can receive it. Of course, in charging, the outside surface probably becomes oxidized first, because it is the nearest, and the other may become oxidized by a kind of electrolytic induction in the mass of the plug itself, and you must give it time for the actions to take place, and I think that by pursuing such a method you do allow the necessary time, and you do not evolve the gases. You do not let the actions take place too fast, so that gases will not be evolved, because when they are evolved they are in a condition where they are the most dangerous, particularly on the oxygen plate, so far as the vitality of the active matter is concerned. The condition which Mr. Prescott has called to our attention is a well known one—namely, that the continued evolution of oxygen on a peroxide plate, after the battery is charged, disintegrates the active matter that it converts the peroxide into a finely granulated form which is not coherent, so that it is not at all desirable—on the contrary, very undesirable—to prolong the evolution of gas. On the other hand, it is quite desirable to charge the battery fully, so as to leave none of the matter unreduced, so to speak. There is no way of doing it so as to meet satisfactory requirements but that of reducing the rate of charge towards the close of the charge.

Mr. PRESCOTT: I would like to ask Dr. Duncan if he took into account the difference in the internal resistance of the cells owing to the different state of charge or discharge in order to calculate the dual effect, and whether he took a mean of a few extreme readings or whether it was determined at uniform intervals.

Dr DUNCAN: It was determined every five or six minutes and the effect was calculated at corresponding times. The resistance for full discharge was sometimes five times as great as it was for full charge plate, when allowed to run down far below its normal potential.

Prof. NICHOLS: I wish to emphasize what seems to me the importance of the point brought out by Mr. Mailloux a moment ago, and the importance of the experiment such as Dr. Duncan has described in the study of the storage battery. It seems to me that this is the only way in which this great number of perplexing questions that have arisen can be satisfactorily answered, and I think the sort of experiments described in this paper, made patiently and persistently, will finally give us complete control of this matter. This question of time is, of course, a very important one in the matter of charging. It would seem perfectly practicable to determine a rate of reducing the charge which should give the proper charge to a battery with the minimum time, never at any time giving it more than it can safely take, so as to complete the charge in the smallest possible interval. However, I think that this has more to do with the economic question of the time of charging than it has to do with the efficiency, and I think so, because in some recent tests which we have been making—they were really practice tests, but they brought out this point very nicely—the battery was charged first with uniform current throughout, at a rate not such as to produce marked evolution and discharge and its efficiency determined. The same battery was then charged with a tapering current, starting off with a large amount and making the average current for the whole time of charging the same as before. The efficiency was found to be within one per cent. of what it was before. Finally the same battery was taken again and charged intermittently with uniform current and then breaking and allowing it to stand for half an hour, the impression being that there might be a reversible reaction which would take place so that the battery would have an opportunity to readjust itself between these charging periods, and it was brought to the same condition and again discharged continuously, and all three of these efficiencies came out between one or two per cent.

Mr. F. B. CROCKER: I would like to ask Dr. Duncan if the question of loss of energy by the evolution of oxygen and hydrogen could not rather easily be determined by collecting the mixed gases. He refers to it as an unknown factor in the loss of energy. It seems to me the number of unknown factors could be reduced by determining the amount of energy the gases represent. The point which the president brought out, of a recombination of the oxygen and hydrogen, would be eliminated from that also, because the gases collected would represent the actual loss of energy from the evolution, and

* Probably due to the Peltier effect between the plates and liquid.

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recombination would be heat added to the heat produced from the battery. It seems to me this factor of loss could be fixed in that way with comparative ease and leave only one or two to settle.

Dr. DUNCAN: I think I was misunderstood if it was supposed that I said that the loss due to electrolysis of the solution was not a definite quantity. When you electrolyze a solution of sulphuric acid you get a definite, certain amount of oxygen and hydrogen. That has been done by Gladstone and Tribe, but they found that that is a definite amount. But accompanying that is another loss. Gramme found that in electrolysis with dilute acid the efficiency of the process was not much more than 60 per cent. under the most favorable condition. It is not the 60 per cent. of the loss due to electrolysis that is at all questionable, but where the other 40 per cent. goes to. There is a heating which goes on entirely independent of the C^2R effect, and what that heating is I don't know. Probably what Professor Thomson suggests will account for some of it. I do not think it would account for all, because most of the calculated amount of gas was collected by Gladstone and Tribe in their experiments.

Mr. MAILLOUX: I think that in considering the question of the work lost in practical electrolysis, we must take into consideration the amount of heat which must be abstracted from the surrounding medium by the expansion of the gas. We must remember that as it is evolved into gaseous a form it expands, and in doing so it would necessarily come within the province of thermo-dynamic laws and absorb energy from surrounding substances, and as this energy must be provided by the circuit itself it would probably react on the circuit in such a way as to cause either an increase of resistance or some loss from counter-electromotive force or otherwise. There are only two ways in which energy can be abstracted from the circuit proper; just the same as in the case of a transformer or motor or dynamo; that is to say, either by inductive resistance in the form of counter-electromotive force or by means of an ohmic resistance. I might point out that the very able and interesting researches of Dr. Duncan will greatly facilitate the mathematical treatment of the storage battery, which thus far has been waiting for just such researches.

Mr. PRESCOTT: There is one point that I consider of very great importance which Dr. Duncan has passed an opinion on, to the effect that the active material applied to the surface of the plate produces better effects than when applied to a perforated grid. I should like to ask him what he considers the surface of the plate. Is it the surface exposed to the acid or is it the surface of the oxide in contact with the lead. Mr. Wolcott has made a diagram on the board which shows that the most effective surface is that in contact with the metal itself, and if that is true why I should think the objection to the grid form would fail.

Dr. DUNCAN: While action takes place all along the grid, yet if the diffusion is not very rapid the action at this part is taking place in comparatively strong acid, and the action here (indicating) is taking place in comparatively weak acid. At the same time the condition of those points is different; therefore, the loss will be different. With two plain sheets, one opposite the other, the density would be exactly uniform, supposing the conductivity of the support were great enough. As far as the efficiency goes, the only experiments I have made, as I have stated, were with the deposit of peroxide upon plain lead plates from a caustic solution of litharge. If you take a very concentrated solution of caustic soda and potash and put litharge in and boil it, and put in two plates, you get on the lead plate a deposit of spongy lead which will be a half inch thick for one-quarter of an ounce. Then you can press that until it is about 1-100 of an inch thick. You can get about 6-10 of the theoretical capacity of the lead when it is compressed with a pretty fair pressure. But it was with such plates that I got a higher efficiency than I did with these plates, because their action is perfectly uniform and the thickness is so small that there is no chance, hardly, of eddy currents.

Mr. PRESCOTT: Therefore it is possible that the same method of preparing the plate if applied to the grid might have given the same result.

Dr. DUNCAN: The great point here is that every point on that plate is in exactly the same condition. The distance from the other plate is exactly the same. Whereas here (indicating) there is a very great difference, and consequently the distribution of current here is the same. The chemical action is uniform. Here the distribution of current is different, and therefore the chemical action is different.

Mr. PRESCOTT: The modern practice is to increase the separation of the plates very much more than has ever been done in the past, and also to make much thicker plates and to make smaller perforations. The result is that the difference in the distance between one plate and any portion of the interior of the perforation of the opposing plate is almost inappreciable. That is the modern tendency.

The Edison Electric Light on Board The "Pouyer-Quertier."

The superiority of electric light over other methods of illumination is nowhere more noticeable than on board ship, and no first rate steamer of to-day is considered complete without an electric plant. Realizing this fact, the Compagnie Transatlantique, the owners of the cable steamer "Pouyer-Quertier," have taken advantage of her long stay in Boston to have her thoroughly equipped with the electric light throughout. After due consideration, the Edison system was adopted, and Messrs. Paine & Francis, the eastern agents of the Edison company, secured the contract.

A very convenient place for the engine and dynamo, 12 feet square, was found in the engine hatch, immediately under the skylight, and directly over the main engines, and a strong iron framing was erected for a foundation. No better place could have been chosen, there being plenty of light, and the dynamos being far removed from any possibility of getting spattered with oil or water from the engines below. The engine, supplied by B. F. Sturtevant, Jamaica Plains, Boston, possesses some novel features, and is admirably adapted for ship use, where space is valuable and high speeds are necessary. It is of the double-acting double type, having two cylinders, 7" × 5", with cranks directly opposite one another. There is only one valve for the two cylinders, of the piston type, under immediate control of the fly-wheel governor, the steam ports in the cylinder next the valve being large enough to admit steam for both cylinders. A steam passage leads from the top of one cylinder to the bottom of the other, so that steam is admitted to both cylinders at the same time, but acting in opposite directions. The crank shaft is of cast steel and has extra large pins, 3½ inches by 4 inches, to prevent heating at high speeds. The journals run in self-feeding brush-oiler boxes, and all the bearings throughout are fitted with stationary sight feed oilers, with tubes leading to bearings and communicating with wipers. The cross-head is of the locomotive type, lightly constructed, with steel plate sides, strongly riveted, with easily adjustable gibs, traveling on a steel bar for a guide. One of the most important features of this engine is that the working parts are completely incased, and yet are readily accessible by doors in the engine casing, in front and in back. This engine governs within .87 of one per cent. with varying load, which will assist materially in keeping a constant potential at the lamps.

The dynamo is compound wound, and is capable of furnishing from one light to 125, being fitted with the most recent type of compensating spool, preserving a constant pressure at the lamps. A hand regulator is also provided for use when necessary. The dynamo is driven by a specially constructed cotton belt furnished by the Eureka Hose Co., which was chosen on account of its reputation for never stretching. The switch-board is neatly arranged over the dynamo, and is furnished with a Deprez-Carpentier voltmeter and ammeter. The switches are all on porcelain bases, and the cut-outs, also made of porcelain, are placed on the switch-board, rendering them very accessible, instead of being distributed in the usual manner over the ship. The circuits are divided into eight, and the wires are incased in galvanized iron pipe, from the switch-board to the lamp, the lamp socket being actually attached to the pipe, though insulated from it. On account of the ship being fitted with water-tight bulkheads, the wires have had to be run chiefly on deck, and this system of running the wires in iron piping becomes doubly valuable. The iron piping is also used in the tanks, and fore and after holds, the wires being moulded only in the cabins and saloon. The saloon, cabins, tiller room, pantry, officers' quarters, mess room and galley have independent lights, whereas the tanks, engine-room, shaft alley, dynamometer lights, lights in forward and after holds are controlled by switches in the dynamo room. Special attention has been given to the deck lights to enable the cable hands to make repairs with as much dispatch during the night as in the day time. Lamps have been placed at each of the dynamometers, fore and aft, and clusters of lights have been provided with flexible cables for hoisting into the rigging, so as to send down a flood of light on any part of the deck where the men may be at work. Two 50 c. p. lights have been placed on the sheaves, fore and aft, for reflecting down on the cable as it comes over the pulley, and a submarine light of 50 c. p. is being provided in case the cable should at any time foul with the propellers. The fixtures for the deck lamps and for the lamp on the sheaves, are all easily detachable, and special attention has been given to make the sockets, receptacles and plugs thoroughly watertight. The wire used throughout has been specially constructed for this work by the American Electrical Works, of Providence, and is of unusual excellence. Twin wire has been adopted through out, and the flexible cables for hoisting in the rigging are designed to withstand the roughest usage. All piping, valves and other fittings have been provided by Wm. H. Gallison, of Boston.

Captain Stewart Fossard and Electrician Frank R. Fisher express themselves well satisfied with the light, and great credit is due Messrs. Paine & Francis, under the able supervision of Mr. Bush, for the thorough manner in which the work has been done.

Mr. Wiman on the Telephone and Telegraph.

In our notice a couple of weeks ago of Erastus Wiman's address at the New York Electric Club, we quoted his views as to the low value of electrical securities and the desirability of an electrical trust. His ideas, as given below, on the relations between the telegraph and telephone, are also interesting:

If a man should say that he could do without electricity these days—as a business man, if he said I will never send a telegraph dispatch or speak over the telephone, he would soon be completely lost sight of by the whole community. The more active a man is, the more regular in his use of electrical appliances, the more certainly he will be successful. It reminds one of Disraeli's expression, "He who has the best information is the most successful." Certainly he who has the best facilities is the one who achieves the best results; and if a man orders out his telephone, it is a sign that that man is running behind. If he does not make use of the telegraph as freely as his competitor does, his prospect is hopeless in this race for distinction.

The relation between the telephone and telegraph is a very peculiar one. Parties interested have watched with a great deal of interest the effect of the telephone upon the telegraph, and I am not prepared to believe that the telephone hurts the telegraph very much. Between near-by stations, where the telephone is fully developed, there may be less telegraph business than formerly. At the same time, there is an enormous area covered by the telephone that the telegraph never would have covered, and there is an enormous development of telegraph business from just that fact.

There are those who think the telephone helps the telegraph because the Western Union Company continually increases its business, in the face of an enormous growth in the use of the telephone. The telephone has been described as the express train, and the telegraph as the freight train of modern communication. Some have said it was a great misfortune that they were not united at the start. I say it was a great blessing that they were divorced, because I do not believe that the telephone would ever have been developed to one-quarter the extent to which it has been developed, if it had been dependent on the telegraph. The development of the long distance telephone will greatly stimulate the completeness of the telegraph and it needs stimulating.

With all due regard to that noble institution, the Western Union, I have heard it said that if the devil himself had arranged things he could not have fixed matters worse to accommodate the public than has been done. I do not know whether it is because Mr. Gould sits on the company like an "Old Man of the Sea," or whether because, of the nature of things, it impossible to do all that the most unreasonable may demand, but a spirit has been developed regarding the Western Union that is most unjust. It to-day performs a service to this country of stupendous magnitude, at a cost so slight as compared with what prevails elsewhere as to equal distance, that it deserves the highest recognition. True, some fellow with a new patent comes along; some crank that thinks he "knows it all," tries to get the ear of the magnates and is chagrined if he cannot. It is true they have spent large sums experimenting, but it was a necessity of the new art in which they were engaged. But to-day the Lord help the man who goes to the Western Union with a new scheme. They have got to be the most practical, hard-headed set of men on new schemes that the country contains; and the fact that they are doing such a splendid service, permeating the business circles so completely, and hourly and daily helping forward the great march of civilization, is the best evidence that they are right in discouraging speculation or inventive enterprises.

With regard to the Bell telephone, prudent business men consider there is not in all the world a career more practical, more sagacious and more successful than the career of the management of the Bell Telephone Company. The fact that they have just now, by the unanimous and hearty approval of the authorities of Massachusetts, doubled up their capital and made it twenty millions, is an indication of the result which has been obtained by them. The fact is that the telephone people have been so far-seeing and so prescient, as it were, in their operations, that it would not make a bit of difference if their patents were out of sight to-night—they are in the position of a standing army, commanding every strategic position, and in the attitude of armed occupation, fulfilling every day and hour a higher duty, a better service, a more complete, comprehensive usefulness to the people of America than any other known device.

When it is realized that there are 1,055,000 messages a day passing during the ten hours, and often twenty-four hours—1,055,000 messages a day going backward and forward, on every conceivable subject—why, all humanity is interested. Almost every person is concerned, remotely or directly, in the talk that comes over the telephone. It permeates our national life, and is woven into our every day existence most marvellously. There is much credit due to Mr. Bell, to Mr. Edison, to Mr. Forbes, to Mr. Gardiner Hubbard, to my good friend Mr. Vail, to you, Mr. Madden, and others who have been associated with him, that this great facility of usefulness has been so universally promoted in so short a time, and that it is so generally useful, successful and profitable.

There is something strange about the concentration of effort inaugurated by the telephone and the telegraph, especially in its contributions to the combinations of capital and industries, which are now the curious and necessary feature of the time. Competition, when it is taking the profit and life out of business, must result in combination. It is as sure as the sun shines, and it is curious enough how the telegraph and telephone helps that tendency. There is a friend of mine living in the northern part of this State. There are ten or twelve establishments right around him that formerly competed to the loss of all. Some time ago it was proposed to group these in one combination, and now ten or twelve competitors, who have been running against one another, unite in one business, the executive part of which is done by one man. He is found sitting in his library and communicating with the dozen places around through the telephone, doing business better, at less cost to the public, and with profit to his associates. My friend, Wellington R. Burt, of Michigan, controls the output of several hundred different salt works, miles and miles apart, in the State of Michigan. He has in his hands the distribution of more than one-half the total output of salt of the entire continent, and has made a great success of the Michigan salt field, while without some such control, loss and disaster would have followed. It would have been perfectly impossible for him to achieve this without the telegraph for distant messages, and the telephone for near-by communication, so that the concentration of capital and the possibility of combination are the results of electrical facilities.

The business man without realizing it looks upon electricity as an additional sense. It is something in the shape of power that he is clothed with, something that goes out from him at his bidding. He has always had his ears and his eyes and his nose, all his senses of seeing, hearing and feeling, but here is a newborce that enables him to instantaneously transmit his intelligence—his will, his command, in any direction he chooses.

The perfection in the means of communication is the highest sign of perfect civilization, and the perfection of communication in the telegraph and the telephone shows how far we have progressed and how completely we arecivilized. It is said that man is the only animal that can make a fire, that through the success of making a fire he can burn coal, and from that he can make electricity, and with electricity he can make light, and from electricity he can make power. The savage who asks another savage in the forest for something to eat is the first and lowest form or means of communication. The highest form is that when we can send a dispatch from one end of the continent to another by telegraph and when we can talk by telephone from Chicago to New York without interruption.

Telegraphing the News of the Derby.

The Direct United States Cable Company has again made a new record in the time occupied in sending messages between London and New York in conveying the result of the Derby to New York in the unprecedented time of two seconds. The transmission of the news on June 5 between Epsom Downs and the United Press office was continuous, so that in reality the time occupied may be said, without exaggeration, to be incomputable.

With regard to this, Mr. Walter P. Phillips writes as follows to Mr. J. Brown, the superintendent of the Direct Company: "According to Benedict's time, we received the result of the Derby race over the wire connecting our office with yours at 10.08.30 A. M. We were waiting on our various circuits connecting us with Boston and intermediate points, Buffalo and intermediate points, Chicago and St. Louis and intermediate points, and the offices of the various newspapers served by us in this city, and before your operator had finished sending the word "Donovan" we had begun that word on each of the circuits referred to, and within two seconds of the time that you finished the word, our bulletin announcing the result of the race had been distributed over each of the circuits worked direct from this office. In all probability the result of the Derby has never been announced in this country with the promptness with which it was done by the Direct Cable Company and the United Press to-day. So far as I have heard, we were at least fourteen minutes ahead of all competitors. It is needless to say that we appreciate the service you gave us, but on behalf of the United Press and its clients, I desire to thank you for it."

Telephone Amalgamation in England.

The long-talked of amalgamation of the three leading telephone companies, writes our London correspondent, is now a "fait accompli." Your readers will, no doubt, recollect that the scheme originally proposed was vetoed by the Postmaster-General, who refused to sanction the transfer of the present companies' licenses to a new concern to be called the Telephone Union. The amalgamation of the three companies is now effected by the purchase of two of them by the third, the latter company giving its shares as the purchase price. This arrangement, which will take effect as from May 1, is the outcome of lengthy and delicate negotiations, and it is to be hoped that its ostensible object, namely, the extension and improvement of interurban telephony, will now be achieved. The purchasing company is the National Telephone Company, whose license covers the whole of the United Kingdom, and the two companies absorbed are the United and the Lancashire and Cheshire. The area worked by these three companies includes the whole of Scotland and all England north of the Thames, with one small exception, and comprises the chief industrial and seaport towns in the Kingdom. The companies not affected by this arrangement are the Western Counties and South Wales, the south of England, the Northern District and the Telephone Company of Ireland, whose districts, although equal in extent to those worked by the amalgamated companies, are of comparatively secondary importance.

The Disaster at Johnstown, Pa.

Brief reference was made in these columns last week to the awful disaster which, on the afternoon of May 31, fell upon the valley of the Conemaugh, in Pennsylvania, and practically wiped out of existence the city of Johnstown and its populous suburbs. The discharge of waters from Conemaugh Lake, through the broken dam at South Fork, interrupted telegraphic communication, and for some days the actual extent of the catastrophe was not known. The renewal of the telegraph service put the whole world in possession of the sad intelligence that not less than 3,000 and perhaps more than 5,000 lives had been lost, and that property to the value of at least $25,000,000 had been destroyed.

One of the saddest episodes was the death of Mrs. H. M. Ogle, who, with her daughter, was in charge of the Western Union office. When the rumors of the coming trouble flew through the town, Mrs. Ogle refused to leave her post, but stayed at the key and sent the alarm to all the offices down the valley. Finally, and in a few brief minutes, "This is my last message" came over the wire, and nothing more was known of this heroine until her body was recovered.

By a singular coincidence Mr. W. H. Smith, the head of the Associated Press, was on a Pullman train which was caught at Johnstown by the whelming tide, and he narrowly escaped with his life. Being on the spot he thus was able to superintend the news service, and to supplement the doleful daily bulletins by a graphic account of his own thrilling experiences and observations as an eyewitness.

Speaking of the condition of affairs, a correspondent on the spot says: "Many friends of those who lived here sent telegram after telegram making anxious inquiries, but received no answer. It was only yesterday that these telegrams began to come in. For several days there was but one wire here, and that was monopolized by the Relief Committee. Most of the dispatches for this place were written out in Pittsburgh and sent on here by train, and at headquarters here they have been sorted out in alphabetical order. They are handled daily by thousands. Outside the building a written list is posted of those for whom telegrams are waiting. The Western Union office up to Thursday night has sent out over 100,000 words of press matter and about 8,000 private telegrams assuring friends of the safety of survivors or announcing the loss of victims. All this vast mass of matter has been handled by 16 men, who have lived in two little tents on the hillside above the woodshed which has been their office since the fatal Friday."

Last week Dr. Norvin Green, President of the Western Union Telegraph Company, addressed a letter to Mayor Grant, stating that a general order had been issued to Western Union superintendents and managers to send free all messages relating to measures and contributions for the relief of the Johnstown sufferers. The free use of the wires has thus been open to all benevolent persons interesting themselves for the purpose of extending the promptest relief to the sufferers from the great disaster.

It is needless to say that all the telegraphic, telephonic and electric light plants in Johnstown were destroyed. How far the débris can ever be utilized again is still unknown. The Johnstown Electric Light Company had a fine Edison plant of 4,000 or 5,000 light capacity, which had been in successful operation for three or four years. So late as last week the company were in correspondence with the parent company in this city as to the extension of their street "municipal" system. At the Cambria Iron Works there was a Thomson-Houston arc plant. The Johnson Street Steel Rail Company, who do a large business with electric railroad companies, are understood to have suffered severely, so that it may be some time before they can fill all their orders, from their Johnstown works, for rails, etc., for new electric roads.

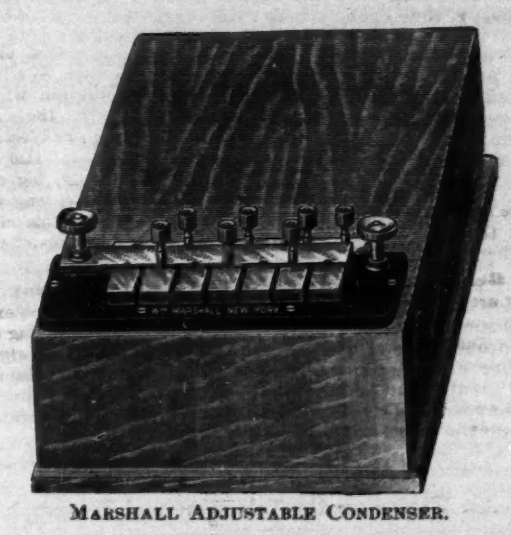
The silver lining to this dark cloud of disaster has been the universal liberality and charity with which the wants of the survivors have been met. At the present time about $2,500,000 has been raised, and it is believed that another million will be added during the current week. In New York, over $500,000 has been raised and sent, either through Mayor Grant's hands or direct. It is pleasant to see how prompt the electrical interests here as well as in other parts of the country have been in responding to the cry of distress from the Conemaugh Valley. We hear from Pittsburgh, so near to the scene of disaster, that the various Westinghouse enterprises have contributed royally and that the managements have been active in the noble work of relief. Among contributors in this city we note the Commercial Cable Company, $500; Jay Gould, $1,000; the Stock Quotation Company, $100, John Stephenson Company, $100; Fairbanks & Co., $500; E. P. Gleason Manufacturing Company, $100; Chas. A. Schieren & Co., $100, and their employés $61; the American Leather Link Belt Company, $25; the Gamewell Fire Alarm Company, $25; Wallace & Sons, $100; the New York Belting and Packing Company, $500; Oxley, Giddings & Enos, $100, and their office employés $25; Abendroth & Root Manufacturing Company, $100; A. A. Cowles, $25; the Ansonia Brass and Copper Company, $250, and their employés $36; Spencer, Trask & Co., $250; the Edison United Manufacturing Company and their employés, $266; Bergmann & Co., with employés, $485; the Edison Lamp Company and employés, $250. The Edison Machine Works at Schenectady raised and sent $800. In short, the outflow of charity was so universal, it would be easier to make a list of the exceptions—if there be any—than of those who gave.

Among the appliances of relief at Johnstown has been a portable electric light plant mounted on a flat car on the railroad. Its light is very cheering and serviceable.

The Conemaugh Lake that has thus emptied itself over a smiling and industrious valley, spreading ruin and desolation, has for some years past been used for purposes of sport by residents in Pittsburgh. Many of our readers will doubtless remember that in THE ELECTRICAL WORLD of Sept. 22, 1888, was illustrated and described a catamaran operated by "Electrical Accumulator" storage batteries, and belonging to Mr. Louis S. Clarke, of Pittsburgh. This dainty little craft was called the "Spark." She was launched on July 4, last year, and remained in successful operation during the season, making four miles an hour on the waters of the placid Conemaugh lake.

Marshall's Adjustable Condensers.

Mr. Wm. Marshall, whose condensers are well known, has just issued a neat little pamphlet containing a short treatise on the uses to which condensers may be put and illustrating some new styles of instruments. His multiple series adjustable condensers have already been illustrated in these columns.* We illustrate below the type of



MARSHALL ADJUSTABLE CONDENSER.

adjustable condenser used by the Western Union Telegraph Company on their Wheatstone automatic service. This condenser has a total capacity of 6.75 microfarads subdivided into seven sections, as follows: 2, 1.5, 1, 1, .5, .5 and .25 microfarads.

The Eiffel Tower and the Spectroscope.

The Eiffel Tower may be said to have commenced its expected career of usefulness as an aid to scientific investigation in a sufficiently startling manner. According to the Paris correspondent of the *Daily News*, M. Janssen, of the Academy of Sciences, claims to have made a discovery which upsets the entire theory based on the analysis of celestial bodies by means of the spectroscope. On a recent Sunday the electric lamps of the Eiffel Tower were turned on the Meudon Observatory, which is 7,800 metres (4 miles 7 furlongs) away. He reckons that the mass of air lying in a given section of that length at the height of the tower is equal to the atmospheric mass above. M. Janssen argues from this that the number of molecules of air encountered by a beam of light sent from the Eiffel Tower to the Observatory is about the same as that met by sunlight on its way to the earth when the sun is near the zenith. He then shows that, if the analogy holds true, the belief that the sun contains oxygen is unfounded, and that if its spectrum contains the characteristic oxygen rays, this is due to the oxygen of our atmosphere. One of the fundamental theorems of spectrum analysis is that the width of the characteristic bands of a gas is proportionate to the number of molecules that intercept the light. Now, in the recent experiment the most important rays of the oxygen group were precisely similar to those of the solar spectrum. The conclusion M. Janssen draws is that there is no oxygen in the sun.

Resumption of Ticker Service.

After a brief spell of silence, the tickers were put to work again last week, owing, it is said, to the influence of Mr. Gould with the authorities of the Stock Exchange. So far as can be learned, the Stock Exchange policy has virtually forced the Gold & Stock and Commercial Telegram companies together, that is, in the sense that they will work in harmony, so that hereafter the Exchange will not enjoy the benefits of competition. The first effect that each individual member of the Exchange will feel will be an advance in the monthly rental of his "ticker" from $10 to $25. That is the rate the Gold & Stock Telegraph Company will charge hereafter. It is understood that its machines are to be leased only to members of the Exchange, or those whom they may approve or indorse. The general public, that is, the hotels and other resorts that want tickers, will have to content themselves with Commercial Telegram tickers, which are to be run a certain number of minutes behind the Gold & Stock "tickers." This arrangement means that the public is to be given the information it wants, but if it wants the first edition of the market's daily history it must go to the office of the regular Stock Exchange broker.

As to the report that the Western Union Company had absorbed the Commercial Telegram Company, President A. B. Chandler of the Commercial Company said: "It is not true that any sale or other disposition of the property of the Commercial Telegram Company to the Western Union Company or to any other corporation or person has been made. No change in the price charged for tickers will be made without due notice. The present distribution of the quotations of the Stock Exchange has been undertaken for the convenience of the members of the Exchange and all others in interest. The Postal Telegraph Company accepts the quotations from the Stock Exchange, for which no payment is charged. The service is simultaneous by both companies as heretofore, and the conditions under which it is undertaken are uniform."

* See THE ELECTRICAL WORLD, Oct. 8, 1887.

Mr. Harold P. Brown on Insulated Wires.

To the Editor of The Electrical World:

SIR: Some of these days I trust that my circle of "friends and enemies" may learn that it is not my custom to make a statement in print for which I have not what seems to me trustworthy evidence of its truth. I say this on account of the item in your issue of June 1, which makes it appear as though I were hiding from the wrath of Mr. Godfrey, and that I had made a statement concerning the celebrated Grimshaw wire which was not in strict accordance with the facts. This was news to me, as I had a very pleasant talk with the gentleman in question a few days previous, and he seemed to be perfectly satisfied that my sources of information were reliable. I have in my possession a note from one of the authorities who was in charge of the installation of the alternating current plant in the North River Tunnel, in which he states that the contract called for Grimshaw white-core wire throughout, and that it was used at the time. It is only justice to this most excellent wire to say that recent events have proved that the alternating current can induce a static charge in any conductor which is outside the insulation of its wires, whether it be lead covering or, as in this case, simply moisture; and it is well known that a static discharge may pierce even plate glass. Some years ago Dr. Hopkinson called attention to the fact that converters would serve at the same time as condensers, and, as such, might deliver a dangerous shock; but it is within the past few weeks that this danger has actually led to fatal results. In the case of the killing of James Maroney on May 8 in the tunnel, by leaning against a secondary wire while sitting on the air pipe, it was undoubtedly a static discharge which punctured the insulation and formed a path for the current itself. The death of Thomas Madigan in the basement of the Grand Windsor Hotel on April 24 was an exactly similar case. The unfortunate man, while standing on a pump designed to raise water for the elevator, lost his footing, and to save himself from a fall, grasped a secondary wire running along the ceiling. He was hurled violently to the ceiling, and fell dead to the floor. The wire was a waterproof insulation, and there was no apparent break in it, though there must have been a pin-hole made by the discharge itself, which escaped notice. I have also a letter from an official of the Westinghouse local company at Pueblo, telling of the death of a fireman named James Carney at a fire last month by touching a wire leading to a five-light converter. The sooner these facts are recognized, and practical attempts made to guard against this danger, the better it will be for electric lighting companies; but it will not do to put the blame upon the insulation of the wire used. At a visit to the Hoosac Tunnel plant a few weeks ago I was presented with a piece of lead-covered cable which I was told had occasioned a burn in one of the dynamo armatures. It clearly shows the characteristic marks of electrolysis along the outer covering, and in one place the wire had been grounded and the cable burned completely off. The insulation was evidently not to blame for this accident. This leads me to expect lively times in the future for alternating current stations using underground lead-covered wire where the lead is not thoroughly protected from moisture.

NEW YORK CITY. HAROLD P. BROWN.

The Ideal Dynamo of the Future.

To the Editor of The Electrical World:

SIR: In the last number of THE ELECTRICAL WORLD appears a short note from Mr. J. T. Elliott, the treasurer of the Schuyler Electric Company, in which he questions the statement made by the writer that a fire-proof armature had not yet been produced, and further claims that his company are producing armatures that are "proof against a burn-out." Evidently he does not consider the scope of his statement. Can a wooden building be said to be "fire-proof" simply because it has never burned down? Is wood fire-proof anyhow? The Schuyler armature is, I believe, wound with cotton-covered wire. Is cotton fire-proof? In justice to the Schuyler Company, however, the writer will say that he has seen a Schuyler 50-arc machine in operation at the station of the Edison Illuminating Company in this city (Altoona), and will add that the "ventilation" of the armature is certainly excellent. But to make the broad statement that their armature is "proof against a burn-out" is like claiming that a 2,000 volt alternating current is "perfectly safe."

The ideal dynamo of the future contains no cotton at all, asbestos, mica, porcelain, etc., being used throughout. The conductors will stand a temperature of 500 F., and the insulation still remain intact. The armature coils will be fastened to the core as securely as the driving-pulley is fastened to the shaft, for the power applied to both is precisely the same.

There is no more excuse for ever burning out an armature than for an engine to knock out its cylinder head, and yet this continues to be repeated under our very noses; and with all the ingenuity of electricians and their infinite knowledge of "Foucault currents" and "characteristic curves," they have never yet investigated this simple matter—the mechanical driving of armature coils.

ALTOONA, Pa. H. FRANKLIN WATTS.

Electrical Opportunities in Southwestern Missouri.

The region of Southwestern Missouri is enjoying unusual prosperity, and there are excellent indications of a rapid but healthy growth in many towns.

NEOSHO,

one of the prettiest towns in the State, and surrounded with unusual natural advantages, is growing rapidly, but has neither gas plant nor electric light system, though the population numbers nearly 4,000. Some time since a franchise and city contract were granted to a party who promised to install the Thomson-Houston system, but failed to do anything. Thirty arc lights and 300 incandescent lights will find a ready sale, and a franchise and city contract can easily be secured. Excellent coal can be laid in furnace room for two dollars per ton, and the supply of pure spring water is unlimited.

AURORA, WEST PLAINS AND BROOKFIELD

are agitating the question of electric lighting, and parties are endeavoring to push the matter through quickly.

WARRENSBURG, MO.

Here the subject of electric lighting has become as stale a chestnut as are the petty internal dissensions that retard the town's growth, while a few sickly gasoline lamps light the main thoroughfare. Last week a gentleman of known financial standing offered to have an arc and incandescent plant in operation within sixty days if a franchise (not an exclusive one) was granted, and the mayor, good, genial Dr. Hunt did all he could to influence a favorable action of the council, but without success. Fifty arc lights and two hundred incandescents could easily be placed here. Coal of superior quality costs about $1.75 delivered. As it is hauled direct from the mines suitable arrangements for the storing of sixty to one hundred tons would have to be made before winter set in. Water is rather scarce and a special well would have to be sunk. Mr. J. Christopher, the genial owner of Perth Springs, a noted summer resort near Warrensburg, Mo., contemplates installing a combined arc and incandescent system unless a central station plant is erected in the city. Fortunate indeed will be the agent who partakes of the hospitality of "Jim" Christopher; and whether sale is made or not, green will the memory of that visit ever be.

WEBB CITY, MO.,

requires a lighting plant, and Mr. J. C. Stewart, of the Centre Creek Mining Company, is securing estimates on the cost. As the numerous lead and zinc mines would gladly subscribe for a large number of arc lights, the investment will prove a profitable one. A number of lights can also be placed in Carterville, a mile distant from Webb City. Numerous incandescent lamps could be placed in the mines.

POWER TRANSMISSION.

An English syndicate visited the mining section around Webb City last week and effected a lease of several hundred acres of mineral land five miles distant. The agent, Mr. J. M. Whitsett, suggests the advisability of building a dam across an adjacent stream and constructing an electric power plant of about 500 horse-power capacity, in place of erecting numerous steam plants. The round distance would be about six miles. The feasibility of utilizing the water-power in both Spring River and Shoal Creek, which streams form a junction in Cherokee County, Kansas, about five miles from the Missouri border, has been under discussion for some time. The fall of water is always heavy in both streams, except during the month of August, and by purchasing the two old dams now at Lowell Mills and constructing a new one just below the bridge at the junction of the streams, ample power could probably be secured to operate 1,500 to 2,000 horse-power in small motors in Galena and Empire, four miles distant.

CAMERON, MO.

The good citizens of Cameron, Mo., have long desired electric lights, but there is no money in the treasury and no prospective income to warrant the officials in contracting for city lights. Mr. E. P. Piersal stands ready to establish a plant as soon as circumstances will justify the investment.

COLUMBUS, KAN.,

expects to have electric lights in operation this fall. A franchise was granted a year ago, but no further action taken. Dr. I. P. West now offers to put in a Thomson-Houston plant if a franchise and city contract are granted him.

BAXTER SPRINGS, KAN.,

twelve miles from Columbus, has as neat and attractive an electric light station as can be found anywhere. The Thomson-Houston alternating system is operated by water-power from Spring River, and the lights on the street and in the residences give perfect satisfaction. The owner deserves great credit for having had a model circuit constructed. Straight, handsome poles, neatly painted and correctly set up, are seen everywhere, even to the river's edge. It is proposed to install an arc plant later on.

PLEASONTON, KAN.

Hon. Alfred Beaker has the matter of lighting Pleasonton, Kan., well in hand, and will probably install a plant this fall. He has not yet decided what system to select. D.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, June 10, 1889.

E. P. Hampson & Co., 36 Cortlandt street, were shipping one of their big Eclipse Corliss engines to Buffalo as I passed by, June 1. They report their general business in excellent condition, with a brisk inquiry for engines for electric light plants.

Mr. Robert Coleman has just returned to New York from the flooded district around Johnstown, and has some very interesting stories to tell of his adventures in that section. He has to thank his agility for his life, and does not wish to pass through any such experience again. He is now starting on a trip through the East in the interests of the American Indurated Fibre Company, of 311 Broadway.

The Excelsior Electrical Company, 115 Broadway, are doing an extensive business in light and power all over the country, and take orders for a dozen 5 and 10 h. p. motors now as quite a matter of course. They have recently bought property at Tarrytown, N. Y., on the Hudson, where they are installing a 250 h. p. plant of engines, boilers and dynamos, to increase their arc plant, which has been operating so successfully there; and they are also putting in dynamo capacity for 2,500 incandescents.

Mr. Jas. F. Kelly, general sales agent, Edison Machine Works, for insulated wires and cables, reports an active demand for his goods in all the sizes and varieties of make. They are now preparing for telephone use 20 miles of 100 conductor cable No. 18 B & S gauge, ⅛ inch special insulation, for lead covering; the conductors are twisted in pairs and laid up in reverse layers. This cable is intended for use in conduits. Mr. Kelly also reports an active demand for black weather-proof wire.

Messrs. Curtis & Dean, 115 Broadway, the New York representatives of the Thomson-Houston Company, have just increased the plant of the Dolphin Manufacturing Company at Paterson, N. J., by 500 lamps, with dynamo capacity to match. The Jewell Milling Company's plant in Brooklyn they are increasing from 150 to 300 lights. New Rochelle is adding 500 alternating lights to its present 500-light capacity. There are 130 arcs in use there also. The firm are also getting ready to complete a new station at Mt. Vernon, N. Y., with a capacity of 100 arcs and 600 incandescents.

Mr. A. L. Bogart, of Union Square, is meeting a steady and large demand for his electric gas lighting apparatus and also has a good run of business in the other departments. He has just been fitting up a 300-number annunciator at the Mirror Lake Hotel, Lake Placid, Adirondacks. This annunciator is fitted up with a large plate glass front, all open. The indicators and metal work are of gilt and nickel, and all visible. The case is made of California red wood, richly carved. It stands four feet wide and five feet six inches high.

The Standard Clock Company, 210 West Twenty-ninth street, report themselves as doing an excellent business. They have a large number of their self-winding clocks in active service at Packard's Business College, St. Francis Xavier College, the Hebrew Orphan Asylum, Le Boutillier Bros., and a number of commercial offices down town. They also have a large number of secondary clocks out on service. The company control valuable master patents covering this system. Mr. A. Blumenthal proposes, I hear, to sell State rights for the whole United States to a good party he offers an excellent opportunity.

A Pamphlet on Electric Lighting.—A pamplet, entitled "Important Facts Relating to Electric Lighting," has been published by the Tucker Electrical Construction Company, in which a large amount of information is given as to the introduction of the electric light, and as to its recommendations and advantages. A very interesting section is that devoted to showing the approximate cost of electric lighting as compared with gas, based on figures of the Mather system. The pamphlet concludes with a number of testimonials as to the efficiency and economy of the Mather system, for which, as your readers know, the Tucker Company are the agents.

Messrs. E. S. Leaycraft & Son, 74 Cortlandt street, are well known in the electrical business, as consulting and practical electricians and machinists. Mr. Leaycraft was with the Western Union for 9 years until 1879, and was consulting engineer, in which capacity he laid all the pneumatic systems now in use by the company. The time-ball, which falls at noon every day on the Western Union Building, was an early piece of his work. The firm also installed the immense pneumatic plant at Wanamaker's big dry goods store, Philadelphia. Mr. Leaycraft, Jr., has had a long experience in the electrical line with the leading houses in this city, so that the firm are fully equipped to carry out contracts of any size, either electrical or pneumatic, or both.

The Bentley-Knight Electric Railway Company of this city are full of business and are pressed to get their orders executed on time. They have nine double motor cars now running on the West End road at Boston, and have an order for thirty-eight single motors with power plant to match, including four dynamos of 80 h. p. These single motors are to be run on the overhead system. The company are also supplying the West End road with an 80 h. p. snow sweeper, and with a 40 h. p. street railway motor, which will be the largest of its class in the world, and is intended to handle a whole train of cars if necessary. They are also completing eight single motor cars for a new road at Lowell. The road they are building at Port Chester, White Plains and Tarrytown, comprising sixteen miles of single track, will start with four double and four single motors on the first twelve miles of the road. The whole will be completed in the fall. The power plant comprises three 80 h. p. dynamos, one being a reserve.

The New Anti-Magnetic Watch Case, manufactured by the Atlantic Watch Case Company, 192 Broadway, is meeting with unprecedented success. The company are already in possession of testimonials from several leading electricians, as well as prominent commercial men, referring to the protection afforded the most delicate watch after being placed in this rich case. The convenience of these cases is not detected at a glance. The face of the case has a fine bevel glass, which need never be removed, but should it be desired to remove the face, it can be unscrewed with the utmost ease. The back of the cover of the watch works in the same way. It is made of a fine nickel, combined with a highly non-magnetic metal, and is equal to a fine silver case. It will not tarnish, and while light and handsome in appearance is so strong that one may stand upon it without damaging it. I have myself examined these cases carefully, and given them a test, and can recommend them to those employed in electric light stations around dynamos, to railroad employés in general and to men on electric railroads in particular. These cases cost but little more than the old German silver now sold for nickel.

The Tucker Electrical Construction Company are now comfortably settled and very busy in their new offices, 14 to 20 Whitehall street, about which I wrote recently. Since they moved they have had their hands quite full of work, including a big job of wiring for 5,000 lights in the Plaza Hotel, Fifty-ninth street and Fifth avenue. In the reconstruction of that building the whole of the interior has been ripped out, leaving the bare outside walls; and new floors are being put in. The Tucker Company have installed 60 arc lights throughout to furnish light for the day and night gangs, the light being run from two Schuyler dynamos, driven by two Westinghouse engines. As fast as the work is completed the Tucker Company follow it up and put in the wires for the electric light, burglar alarms, annunciators, messenger, fire and guest call systems. The Tucker Company have also just closed a contract for a complete electric light, messenger, fire, etc., outfit, for Theodore B. Starr's mansion, Fifth avenue and 53d street, and E. C. Moore, of 20 East 37th street, will have the same outfit. The company are also finishing the underground wiring for the complete telephone service through the immense grounds of Archibald Rogers, at Hyde Park, on the Hudson. These grounds are said to cover one thousand acres. There will be a complete central office connecting every part. The Tucker Company have, I may add, the contract for the electrical equipment for the Progress Club, which it is proposed to make the finest building of the kind in the city in this respect.

A Sprague Map.—Some time ago, when England was in a scare as to the rapid progress of Russia across Central Asia to her dominion in India, a party of alarmists visited Lord Derby at the foreign office and requested him to do something in the matter. He replied by advising his visitors to buy a large map. The same advice may well be given to the cable and steam railroad men who have worked themselves up into a scare over the rapid advance of the electric railroad in this country. It is the only thing to give them comfort, and should be very large. A remarkable exemplification of the wonderful growth of the electric railway business is afforded by a map of no mean dimensions which has now been pasted on the walls of the Sprague office in Broad street. This map shows the Sprague roads in various parts of the country, by the ingenious method of sticking on a red label wherever the company happens to have a road. The effect is very striking, and at the present rate it will only take another week or two and another box of red stickers to cover the whole map. While I was in the office last week, word was received from California of a contract for a new road in San Francisco, whereupon a red wafer was at once placed on the map at that point. This is a very good and graphic way of showing the extension of the business, although the company will itself very soon have to buy a larger map in order to find room for the red wafers on it. In this way the map as far as it has gone offers some interesting suggestions as to the popularity of electricity for this class of work in the different sections of the country. The manner in which the labels jostle each other in some regions would indicate either that electricity is amazingly popular on its own merits, or else that the company has a very live agent in that quarter. On the latter hypothesis, some of the agents when they visit the office must have the complacent feelings of those who go to receive the reward of the good and faithful servant; while others, when they see the map, must feel like kicking themselves, and hieing back at once to the scene of their labors with the ambition to paint that part of the Sprague map as red as its size and the relative proportions of the wafers will permit. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, June 8, 1889.

Newton, Mass.—This city is determined to be in the front in everything electrical, and is now calling for bids on a complete police signal system.

Mr. E. P. Sparrow, formerly an expert in the railroad department of the Thomson-Houston Electric Company, has accepted a position with the Jarvis Engineering Company.

Dr. Robert Amory, manager of the Boston Telephone Exchange, has been granted leave of absence for the summer months and he will take his vacation at Bar Harbor, Me.

George S. Barnum, treasurer of the Bigelow Company, was a visitor to Boston this week. Mr. Barnum reports that he is doing a large business at present in boilers, and that many of them are being sold for electric light plants.

Haverhill, Mass., City Hall.—The Committee on Construction of the new City Hall have given much time and study to the question of the thorough ventilation of the building, and in all probability electric motors will be used for driving the two large ventilating fans.

Lowell, Mass.—L. G. Hall and T. F. Maguire have started business together in the electrical supply line. Both gentlemen have had an extended experience with Mr. L. A. Derby, and are fully qualified to carry out all contracts for house wiring, speaking tubes and other electrical work.

Mr. P. D. Richards, of the Vacuum Oil Company, was a caller at this office this week, and reports that he is the happy recipient of oil orders from all around New England. The Vacuum Oil Company are making a special oil to suit the necessities of dynamos, and from the large quantities which are being sold it appears that they have been successful.

The American Bell Telephone Company.—The bill authorizing the Bell Telephone Company to increase their stock from $10,000,000 to $20,000,000 has been signed. With this increase of capital the long distance telephone will be rapidly pushed along, and the day is not for distant now when we may hope to save many miles of weary traveling by the use of this valuable instrument.

Middleboro, Mass.—No decision has yet been arrived at in the dispute between the Middleboro Electric Light and Power Company and the Middleboro Gas and Electric Company. The case has been tried in this city, and a decision will be arrived at in a few days. Meantime the electric light and power company have had their poles located and work will be commenced immediately.

Haverhill, Mass.—Nothing cheers the hearts of electric light men more than proposed extensions of systems already in use. The Haverhill Electric Light Company have been so besieged with orders that they have determined to very extensively increase their outside construction and have called in the assistance of the Wright Electrical Engineering Company, who will undertake the contract. The work will be commenced as soon as material can be procured.

Sawyer & Blake.—Sawyer & Blake, the well known agents of the Sprague Electric Railway and Motor Company of New York, will no longer be known as a business firm among their large circle of friends. These two genial and energetic gentlemen have decided to be known to the outside public hereafter as the New England Electric Company, but will continue to have their offices at 55 Oliver street, Boston, and I trust that they will under the new name receive even larger patronage than before.

The Elevated Electric Railroad Bill has got a quietus for this year, having been defeated in the Senate on a point of order, namely, that it was substantially the same as the bill recently defeated, and that no bill could come up for a second time in the same session. Boston is not defeated, however, and it is claimed that it is only a matter of time till Bostonians are carried to and from business on an elevated structure of which the motive power will be electricity.

Stock Tickers.—These useful little instruments, so familiar to every business man, have been dumb in this city, and many complaints are being made of the hindrance to business. I have no doubt that we shall hear their merry "click" again in a few days, as many are so accustomed to them that it would be a hard thing to get along without them. "Advance" is the motto of the age, and the action of stopping the tickers looks suspiciously like taking a step backwards.

Newburyport, Mass.—This enterprising city, already the possessor of an electric light plant, will soon have established a plant for the distribution of electric power. The plant is being installed by the Wright Electrical Engineering Company of Boston, and the system used is that made by the Robinson-Foster Electric Motor Company. A local newspaper pays a compliment to the Wright Electrical Engineering Company, by stating that "the poles are the finest yet seen in this city, and will be vastly superior in looks to the poles to be seen on every hand."

Executions by Electricity.—Massachusetts is following in the wake of New York, in so far that the Senate Judiciary Committee are considering a bill by which the death sentence may be carried out either by hanging or electricity. This bill is amending Sec. 37, Chap. 215, Public Statutes, and reads: "The punishment of death shall in every case be inflicted either by hanging the convict by the neck until he is dead or by causing to pass through his body a current of electricity of sufficient intensity to cause death, and the application of such current must be continued until such convict is

dead. Such punishment of death shall be inflicted in the manner in which the judges of the court at which the conviction takes place shall determine, agreeably to the provisions of this section, and the sentence shall, at the time directed by the warrant, be executed within the walls of a prison of the county in which the conviction was had, or within the inclosed yard of the prison." The act is to go into effect Jan. 1, 1890.

The Thomson-Houston Electric Company has recently closed the following contracts for electrical street car propulsion: Fulton County Street Railway Company, Atlanta, Ga., 8 miles, 8 cars; Attleboro, North Attleboro & Wrentham Street Railway Company, Attleboro, Mass., 6 miles, 5 cars; Americus Street Railway Company, Americus, Ga., 4 cars; Auburn Street Railway Company, Auburn, N. Y., 3 cars. The Thomson-Houston Electric Company has 50 railways under contract and in operat on.

Mr. C. S. Haley, who has so long and ably represented the Brush Electric Company's interests in Boston, has been called to another sphere of work. Mr. Haley has accepted an important special position with the Thomson-Houston Electric Company, and will now make the Hathaway building in this city his headquarters. Mr. Haley has been extremely successful in the past, and I hope that in the future he will be even more in the van of the great army of electric light men. The Thomson-Houston Company are to be congratulated upon the acquisition of one who is so well known both for his business ability and for his genial social qualities.

The Holtzer-Cabot Company.—Mr. Cabot, of this company, informs me that he has just completed arrangements by which his company become licensees of the Electrical Accumulator Company, of New York, for the States of Massachusetts, Vermont and New Hampshire, in place of John T. Moriarty, who has retired. The Accumulator Company are making considerable improvements in their cell, and Mr. Cabot expects to do a large business in the near future. In Brookline there are a number of cells which have been there for over two years and show no signs of deterioration. The Holtzer-Cabot Co. may be congratulated in their new accession to a large and growing business.

The Thomson Electric Welding Company will occupy their new offices in the Fiske building, No. 89 State street, about June 10. They also will immediately commence erecting a substantial addition to their present factory at Lynn, Mass. They find themselves overcrowded with orders, having several months' work ahead. Among other orders lately received are those of the Trenton Iron Company (Messrs. Cooper, Hewitt & Co.) for machines to weld steel wire cable. The tests on welded specimens of this cable made at the Watertown Arsenal show an efficiency of 82 per cent. of the tensile strength of the original cable. It is based on these results that this apparatus has been contracted for.

"Pouyer-Quertier." During the week I had the extreme pleasure of visiting this interesting cable steamer. The "Pouyer-Quertier," as is well-known, belongs to the French Cable Company and is ably commanded by Captain Stuart Fossard, assisted by electrician Frank Fisher. This steamer has been lying in Boston Harbor since December of last year, none of the cables having in the meantime broken down, and has recently been thoroughly equipped with the Edison electric light. I send you a separate description of the plant. Captain Fossard is a Frenchman, but speaks excellent English, and my thanks are due him for his kindness and courtesy to me during my visit. Mr. Fisher is a thorough Englishman, though his long presence on board the "Pouyer-Quertier" has enabled him to acquire many French idiosyncrasies both in speech and manner. I had a special pleasure in meeting Mr. Fisher, as he is an old friend of Prof. Andrew Jamieson, of Glasgow, well-known in this country as the author of Munro & Jamieson's "Electrical Pocket Book," which has had a phenomenal sale. Mr. Fisher's small "Sanctum Sanctorum" is extremely interesting to all who have ever done any electrical testing, and one could while away hours pleasantly talking on such interesting topics as "locating of faults" and "fishing for cables." I would also add for the information of those who care for these things, that the "Pouyer-Quertier" is possessed of a very excellent *cellar*, and after exploring the tanks and engine rooms, a glass of extraordinary "ordinaire" does not seem to be at all objectionable.

A. C. S.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 City Trust Building, Philadelphia, Pa., June 8, 1889.

Mr. Charles A. Schieren, of the well-known belt-making firm of C. A. Schieren & Co., was in this city last week.

Atlantic City, N. J.—The Edison Electric Light Company is to illuminate Atlantic avenue from June 1 to Sept. 15; consideration, $3,274.05. Simplex arc lamps of 50 volts are being used. Electric lights are being placed on Pacific avenue for the entire length, and the three miles of boardwalk are superbly illuminated with arc lamps placed at frequent intervals.

A Big Operation.—The new building now being erected by the Penn Mutual Company, at 921-925 Chestnut street, will be fitted up with over 1,000 incandescent lamps. The wiring contract has been given to Messrs. Walker & Keppler, but the contracts for the electric plant and fixtures have not yet been considered. This will be a big plum for some enterprising firm.

Walker & Keppler, agents for the Edison Electric Company, have just taken the contract for supplying the plant for the new building now being erected by the Provident Life and Trust Company at Fourth and Chestnut streets. There will be over 1,000 16 c. p. lamps in the entire structure. All the fittings are to be of the best material and workmanship, and no expense will be spared in making this plant first-class in every particular.

Mr. W. A. Stadelman, of Bala, Pa., electrical engineer, of the firm of Chadbourne, Hazleton & Co., agents for the Sprague Company, was married last Wednesday evening, at six o'clock, to Miss Alita Martinez Cardeza, daughter of Mr. J. M. Cardeza, of this city. The ceremony took place at the bride's residence, No. 2,316 Green street, and was witnessed by the many friends of Mr. and Mrs. Stadelman.

Off for Europe.—Mr. S. C. C. Currie, electrician of the United Electric Improvement Company, has sailed for Europe, where he will make a tour of England and the continent with a mission of finding out whatever is new and meritorious electrically, especially in the storage battery line. He will be gone about two months, during which he will visit the Paris Exposition. Mrs. Currie will accompany her husband on the tour.

A New Glass Concern.—The Standard Flint Glass Works, at Sharon Hill, Pa., owned and operated by Mr. William Kuemmerle, Jr., have been purchased by a company, which has been organized under the title of the Delaware Co-operative Glass Works. The chairman and manager of the company is Mr. John H. Yuncke, who is well known as an able and experienced maker of glass articles for electrical purposes. The office will be at Sharon Hill until it is deemed necessary to remove to this city.

Billany & Cochrane have recently opened a depot for all kinds of machinists' tools, etc., at No. 704 Arch street, this city. Their stock includes taps, drills, chucks, vises, forges, belting, packing, nuts and every thing necessary for the complete workshop. Both partners are young men, and are well known in the trade. Although but lately established, their trade is growing to satisfactory proportions, and it is quite proper to predict that in a few years they will be classed among the leading houses in their line of goods.

Baltimore, Md.—A new electric light company is being formed in this city in which Messrs. H. Carroll Winchester, Bartlett O. Johnson and Manager Bloxham, of the Western Union Company, are chiefly interested. The intention is to use the Pennock primary battery for lighting and power and the title of the company will probably be the Pennock Electric Light and Power Company. A contract has already been taken to light the reading and billiard rooms of the Charlton House. The Wheeler reflector will be used for all lamps put up by the company.

The Thackara Manufacturing Company, makers of electroliers, combination fixtures, etc., at No. 1300 Chestnut street, are very busy with their present contracts. The Bellevue Hotel, at Broad and Walnut streets, is to be fitted with electroliers throughout and the Thackara Company have been awarded the contract. The same firm will also furnish the fixtures and do the wiring for the Stratford, a hotel just opposite the Bellevue. Both buildings will be wired in the best possible manner and most of the fixtures will be especially designed for this purpose. Many of the finer suites of apartments will have the globes harmonize in color with the general decorations, and the highest possible artistic effects will be arranged where possible.

A Novel Marine Plant.—Mr. L. B. Eldredge, a well-known yachtsman of this city, is experimenting with a small launch, whose propeller is driven by electricity. The small craft is twenty-one feet long and five feet beam. It is stoutly built to meet all possible emergencies. At the present, Mr. Eldredge has a 1¼ h. p. motor of his own design geared to the propeller shaft, which develops sufficient power to send the launch through the water at the rate of eight or ten miles an hour. Current is taken from eleven cells made by the Self Storage Electric Light and Power Company, at No. 733 Sansom street, this city. Mr. Eldredge is very enthusiastic over the success of his boat, but thinks that better results can be attained and to that end is designing a new and more perfect motor. He says the batteries are doing splendid work and are the best he has ever seen.

Successful Operations at Atlantic City.—The electric street railway upon the Sprague system at Atlantic City is proving a satisfaction to that place, and with the large influx of summer visitors the passenger traffic is increasing enormously, since every visitor takes at least one ride on the electric railway. The road has been inspected by large numbers of street railway managers from different parts of the country, who have visited Atlantic City for the purpose of seeing the latest improvements in the Sprague system which are in use upon that road, and all have expressed themselves as very much pleased with the easy motion of the cars and evident strength of the motors. Each of the motor cars draws one additional car as a tow, though a great many of the motor cars are only equipped with a single 15 h. p. motor, and it seems wonderful, considering the large loads which these two cars carry on some of their trips, that the whole is propelled by a single motor of such small size. Every detail of the road is as carefully constructed mechanically and electrically as possible, and the poles are exceedingly tasteful, having a double bracket and being situated between the two tracks.

The Burton Electric Heater.—The Richmond *State* of May 24 says: "Both yesterday and to-day exceedingly interesting and highly successful tests were made with the Burton electric heaters on the second floor of the house in the rear of the *State* building. Thirty heaters were arranged on the large floor to represent their relative position on two railway cars, allowing fifteen to each car. In another part of the room was a single heater on which the inventor proposed to do some cooking. The current for the tests was supplied by the 'power circuit' of 220 volts. In order to show the different degrees of heating one set of heaters was connected in series of three and the others in multiple. In addition to the heaters, a number of incandescent lamps were suspended from the ceiling of the room, which, by turning a switch, could be made to glow or be cut out at the will of the operator. The test was intended for the benefit of the shareholders of the Burton Electric Company, and between 1 and 2 o'clock a number of them, including Messrs. Lewis Ginter, P. H. Mayo, William Simkin, R. B. Lee, John Chamblin and others called and witnessed the practical operation of the heaters. At this time Dr. Burton had his cooking apparatus in operation, and on it he boiled water and distributed among the visitors a number of eggs, boiled as nicely as could have been done on a kitchen range. It is hardly necessary to say that the shareholders were more than pleased with the operation of the Burton electric heaters, and whatever doubts might have been in their minds as to the practicability of electric heating, these were, after this test, made to give way to the most enthusiastic confidence of its future usefulness."

E. F. C

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, June 8, 1889.

Titusville, Pa., now enjoys the pleasure of having her streets illuminated with electricity, the Van Depoele Electric Manufacturing Company, of Chicago, having installed a 60 light plant there.

The Sycamore, Ill., Electric Light Company have just contracted with the Van Depoele Electric Manufacturing Company, of Chicago, for a 60 arc light plant and 500 incandescents for furnishing illumination to the citizens of that town.

Mr. C. H. Wilmerding, of the Chicago Arc Light and Power Company, in addition to his present duties of superintendent, will also fill the position of secretary and treasurer, vacated by Mr. A. F. Bennett, who enters the service of Crane Bros.

Mr. Ernst Hoefer, formerly with the Electrical Supply Company, has opened an office at 545 Rookery building, as a manufacturers' agent, and has secured several large orders for electric light poles, hard drawn copper wire, etc., and considers his prospects very bright.

Chattanooga, Tenn.—The Tennessee Electric Light Company has just secured from the Common Council of Chattanooga the exclusive privilege of laying conduits for electric purposes in the streets of that city. A sample half-mile subway is to be laid at once, and if the tests are satisfactory, it is presumed that all the telephone, telegraph and electric light wires will be ordered underground. Mr. A. M. Johnson is president, and E. D. Reece vice-president, of the Tennessee Company.

The Branch Office of The Electrical World was moved to-day from Room 44 Lakeside Building to the above address, in order to facilitate the transaction of the business that has so rapidly grown up in the West. The Mallers Building is located corner of Lasalle and Quincy streets, opposite the Grand Pacific, and diagonally across from The Rookery, in the heart of Chicago. It is convenient and easy of access, and a cordial invitation is extended to every one to drop in and inspect the new quarters.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations upon telephone stocks as follows:

Bell of Mo.	$151@$153	Iowa Union	$23@ $25
Central Union	52@ 53	Michigan	82@ 83
Chicago	305@ 315	Mo. & Kansas	63@ 65
Colorado	38@ 40	Rocky Mountain Bell	41@ 42
Cumberland	69@ 70	Wisconsin	115@ 117
Great Southern	31@ 33		

The Van Depoele Electric Manufacturing Company, of Chicago, have secured a contract from the People's Electric Light Company, of Streator, Ill., for a 200 light Mayo long distance incandescent series plant to be used in lighting the outskirts of that city, displacing the gasoline lamps heretofore used. This makes the plant at Streator consist of 60 arc lights, 1,000 direct system Mayo incandescent lights and 200 long distance. The company are now operating in their new station, near the Santa Fe Railway depot, and claim to have one of the most complete and best equipped electric light stations in America.

The Grand Forks, North Dak., Gas and Electric Company, was organized June 1, with a capital stock of $200,000, and the following officers were elected, President, Wm. Budge; Vice President, W. J. Murphy; Secretary, A. C. Labric; Treasurer, A. S. Brooks. Board of directors: Wm. Budge, Alex. Griggs, A. S. Brooks, John Berkholtz, E. M. Prouty and W. J. Murphy. This organization is a consolidation of the Old Gas Company and the Grand Forks Incandescent Light Company. Both plants will be improved and enlarged. The Electrical Department will be under the supervision of Mr. E. L. Castle, the superintendent of the Incandescent Light Company. A new steam plant of about 125 h. p. capacity will be installed at once. At the present time they are operating some 1,200 16 candle power lamps from a Thomson-Houston alternating current dynamo and fifty arc lights, Thomson-Houston system.

Leonard & Izard have just secured an order for installing 5,000 16 c. p. lamps in the works of the Elgin (Ill.) Watch Company. This is the largest isolated plant in the world in a factory building, and, with the exception of the Chicago Auditorium plant, also installed by Leonard & Izard, is the largest isolated plant of any kind in the world. The competition on this job was very sharp. Leonard & Izard bid upon a first-class plant to give certain results under strong guarantees, not confining themselves to any particular make of apparatus. Purchasers of electrical plants seem to be very much inclined to deal with a reputable and non-partisan electrical engineering concern, as in this case, leaving in a large measure the selection of the apparatus to be used to them and securing not only the guarantees of the contractors but also the guarantees of the makers of the apparatus used. On account of the large amount of territory covered, the 3-wire system effects quite a saving in this case. The Edison Company will probably furnish the apparatus.

Louisville, Ky.—The Green street electric railway is now about completed, and is said to be one of the finest in the country. It has been thoroughly installed under the superintendence of Mr. Frederic A. Hill, of Boston, Mass., who has spared neither time nor expense to make it a thorough installation. The well-known Thomson-Houston system is used, and if it proves as satisfactory here as in other places, there is no doubt that in a short time the mule, as a street car motor, will be a thing of the past, as far as Louisville is concerned. Two Heine safety boilers, of 250 h. p. each, furnish the steam for two Ball engines of 150 h. p. each, which in turn drive the two Thomson-Houston dynamos that supply the conductors for a distance of nearly 6 miles. One noticeable feature of the dynamos, which are 80 h. p. each, is the carbon brush that takes the place of the old style wire brush. Ten cars are now completed. Each car has two 15 h. p. motors and is lighted by 5 incandescent lamps, which will be a radical improvement as compared with the flickering oil lamp. The engines and dynamos are now running, and Mr. B. Dupont, the street railway magnate, will at once open to the public of Louisville an electric railway second to none.

Report of the Fire Marshal.—The Fire Marshal has just printed his report for the year ending December 31, 1888. Copies have been issued to electrical people through the kindness of Mr. J. P. Barrett, the well-known and efficient superintendent of city telegraphs. The report contains a variety of interesting matter. Among the causes of fire it is mentioned that out of 1,871 fires only 20 are attributable to electric light wires, or fewer than with fire crackers or cigar stubs. The department has a large system of aerial wires, and also has a very complete underground system comprising 65 miles of single wire, 105,323 feet of cable, 6,604 feet of sectional conduit, 43,784 feet of iron pipe and 1,200 feet of wooden trough. The department has an electrical repair shop, where it does its own repairing work and manufactures new instruments. It may be noted incidentally that the purchase of 500 cells of dry battery for the police boxes is recommended to prevent the inconvenience arising from the batteries freezing. The department reports also on the electric light inspection, from which it appears that 2,309 arcs and 17,717 incandescents were inspected during the year, making a total, with those inspected in previous years, of 42,842 lights. During the year a very marked disposition had been shown to improve the standard of installations, and at a conference held on the subject the representatives of all the principal companies doing business in arc and incandescent business expressed themselves unanimously against underwriters wire. During the year there was a marked extension of electric motor service, so that in January 53 motors were at work, ranging in power from ¼ h. p. to 15 h. p. With regard to the city electric light plant, to which Mr. Barrett has given particular attention outside of his other regular duties in connection with the municipal telegraph service, it would appear that the introduction of the service has been successful beyond expectation. The plant which was installed for the city in 1887 is in regular operation with 104 lamps of 2,000 c. p. and 15 miles of underground conductors running along the river front. The second plant for street lighting recently completed, and with which the river front plant has been consolidated, has thirteen 30 light dynamos. One hundred and seventy five lamp posts have been placed along the streets and 35 miles of underground cable have been laid for the work. A third plant has been installed at the North Side for the water works, where 178 lamps of 16 c. p. are in use, as well as 24 of 32 c. p., placed in the light house beacon, and a ¼ h. p. electric motor which rings a 700 pound fog bell. This plant is found to work very well, and is believed to be the first instance of the employment of incandescent lights in light house work and for the ringing of fog bells.

D.

THE TELEGRAPH.

Tennessee.—The Knoxville, Cumberland Gap & Louisville Railway will build a telegraph line along its road.

Baltimore, Md.—Bonds for $75,000 will be issued by the International District Telegraph and Construction Company.

The "Pouyer-Quertier" sailed for Halifax, N. S., on Friday, where she generally lies when not engaged in repairing cables.

T. M. B. A.—The T. M. B. A. shows figures that compare favorably with those of other co-operative insurance societies. With a growth in membership from 2,089 in 1881 to 3,316 in 1888, and in deaths from 22 in 4881 to 33 in 1888, the cost of insurance has decreased from $12.45 per $1,000 to $11.09. This is contrary to the general run.

Facing the Flood.—When the flood poured into Milton, Pa., a week ago last night, a Western Union operator, John Wolfinger, telegraphed Supt. Gill: "The water is coming in the office, what shall I do?" "Get a gum coat and a pair of rubber boots and stay there," was the quick reply. Wolfinger obeyed orders and remained at his post till the flood subsided.—*New York World.*

Postal Telegraphs, Lisbon.—Mr. Alan Danvers, the well-known English electrician, writes us from Lisbon in regard to the proposed new building there for the Postal Telegraphs. Plans may be sent in until October 28. The first prize is $3,335 and the second is $2,225. A résumé of the plans and requirements may be seen at THE ELECTRICAL WORLD office, and we shall also be glad to place any of our readers in direct communication with Mr. Danvers.

Chicago Bucket Shops.—A special dispatch from Chicago, of June 6, says: Complaints are flowing into the Chicago Board of Trade that "bucket shops" are securing the grain and provisions quotations while the regular patrons of the Board do not. The Board of Trade authorities allege that Murphy & Co., who have an injunction against the Board, are furnishing the outside "bucket shops" with figures. All this they confidently expect will be changed Tuesday. On that date the cases will come up for a hearing before Judges Horton, Tulley and Collins, and the Board expects a favorable decision on its motion that the injunctions obtained by the bucket shops against it will be dissolved.

THE TELEPHONE.

The Tennessee Phonograph Company has been organized at Nashville by W. M. Duncan and others, with a capital stock of $228,000.

The Pendleton, Ore., Telephone Company has been formed by J. E. Bean, F. J. Donaldson, J. Gagen and others, with a capital stock of $4,000.

The Phonograph Dispute.—Messrs. Gilliland & Tomlinson have put in formal notice of appearance, through Coudert Brothers, in the United States Court, in Mr. Edison's suit against them for an accounting for $250,000 worth of phonograph stock. They will demur to the complaint.

THE ELECTRIC LIGHT.

West Troy, N. Y.—Work has begun on the new $75,000 plant.

Columbus, Miss.—The Tombigbee Cotton Mills will put in an incandescent plant.

Jellico, Tenn.—It is proposed to put in an electric light plant at the Jellico mines.

Atlanta, Ga.—The Gate City Oil Company will put in an electric light plant, an engine of 300 h. p., etc.

Hudson, N. Y.—Work has begun on the new plant, at the gas works, of the Electric Light and Power Company.

Westinghouse in London.—The Westinghouse Electric Company have taken offices in Gresham buildings.

Trimble, Tenn.—An electric light plant is being put in at the lumber mill of C. C. Mengel, Jr. & Bro., of Louisville, Ky.

The Pennock Battery Electric Light Company, of Atchison, Kan., has been formed with a capital stock of $250,000.

Ballston Spa, N. Y.—A Westinghouse plant is to be put in, and the town will have 150 lights for the streets and engine house at a cost of $2,325.

Baltimore, Md.—Proposals will be received by the Secretary of the Treasury until June 15 for the electric light wiring of the courthouse and post-office at Baltimore.

Pittsburgh, Pa.—The Allegheny County Electric Light Company has given up the use of natural gas under its boilers and has gone back to coal, effecting, it is said, considerable economy thereby.

Louisville, Ky.—The Brush Company of Cleveland, has recently received orders for plants from the Louisville Bagging Manufacturing Company and the Louisville & Madison Woolen Mills Company.

Buenos Ayres.—About forty cars of lighting apparatus were recently filled up at the Edison Machine Works, Schenectady, the plant being intended for Buenos Ayres, which is to have a fine central station.

Hays City, Kan.—The Hays City Electric Illuminating Company have not yet determined what system to adopt, and are corresponding on the subject. They are getting into shape to begin work on the plant at an early day.

Mayor Grant's Charges Dismissed.—The charges against the superintendent of the United States Illuminating Company of putting up lamps and running wires contrary to law were dismissed last week by the Grand Jury.

Williamsport, Pa., has, like Johnstown, though in far less degree, been a sufferer by flood. It is badly in want of light, and a new Edison plant of 1,000 lights has been forwarded. Mr. Wilson Howell is on the spot and will superintend its installation.

The Westinghouse Electric Company have put out their new meters among their various central station companies to the extent very nearly of 100,000 16-c. p. lamp capacity. The meter seems to do the work for which it is designed very satisfactorily.

Savannah, Ga.—The Brush Electric Light and Power Company, of Savannah, have received the contract for wiring the new De Soto Hotel in that city for 1,300 lamps of 16 c. p. Mr. T. P. Keck is the superintendent of the company, and will have charge of the work.

Sheboygan, Wis.—The Sheboygan Electric Lighting Company has put in a plant from the National Electric Manufacturing Company on trial. Mr. P. Balt is president and treasurer, Mr. A. Leberman is vice-president and Mr. A. F. Leberman, secretary and general manager.

Baton Rouge, La.—The Baton Rouge Electric Light & Power Company and the Baton Rouge Gas Company, lately mentioned as consolidating, have separated, and the former company will add to their electric light plant machinery for incandescent lighting.—*Manufacturers' Record.*

Cardenas, Cuba.—The Thomson-Houston International Company are putting in a fine plant at Cardenas, Cuba, for general lighting. The negotiations were carried out by Mr. G. W. Davenport on a recent visit to the island, and Messrs. B. C. Wilson and W. F. Lincoln represent the company in the work of construction. The plant comprises 1,000 alternating lights and 100 arcs.

Mammoth Spring, Ark.—The Mammoth Spring Water, Light & Motor Company will start its plant with a United States machine. It will confine its business to incandescent lighting. About 400 or 500 lights will be started this year. Mr. R. Greer is the president of the company. The Mammoth Spring is, it is said, capable of developing 10,000 h. p. and is unchanging in volume the year round.

The Edison System in Canada.—The Edison Canadian manufacturing business has been reorganized under the ownership of the Edison interests in America, and under the general supervision of Mr. Samuel Insull. Mr. John Langton, formerly mechanical engineer at Schenectady, is general manager of the shops at Sherbrooke, Que., and Mr. H. M. Francis has charge of the interests of the new concern at Montreal, with headquarters in the new Imperial Insurance Building in that city.

Westinghouse and Waterhouse Outfits.—Among the orders for alternating current central station apparatus recently received by the Westinghouse Electric Company are the following outfits: Sioux City, Ia. (increase), 750 lights; Clinton, Ill. (increase), 750 lights; Yankton, South Dakota, 750 lights; Guthrie, Ind. Ter., 750 lights; and 35 Waterhouse arc lights; Birmingham, Ala., 1,000 lights; Jersey City, N. J., 750 lights; Seattle, Wash. Ter., 750 lights; Montesano, Wash. Ter., 500 lights. These orders bring the number of Westinghouse central stations up to 178.

The Heisler Electric Light Company, of St. Louis, have issued a new illustrated catalogue. It is a tasteful and interesting piece of work, and gives a large amount of information on the subject of long-distance incandescent lighting. It gives views and descriptions of a number of Heisler plants, and a large number of fac-similes of testimonials as to the excellence of the apparatus. On the inner cover is a neat portrait of Mr. Charles Heisler, who deserves great credit for the energy and ability with which he has elaborated and carried to success the system bearing his name. The catalogue will be furnished on application to any one interested.

Danvers, Mass.—An interesting decision has just been arrived at in the Senate with respect to the proposed addition to the electric light plant at Danvers. The town owns a plant which is used for street lighting only, and as the light became favorably known the people began to clamor for commercial lighting. It being contrary to the constitution of the State to allow a city furnishing municipal lights to go into the business of furnishing also commercial lights, a special bill was introduced to enable this city to evade the law. This bill passed the House of Representatives, but has just been killed in the Senate on its third reading, and the citizens of Danvers will be forced to continue the use of other illuminants than electricity for the present. This measure is especially felt in a town of the size of Danvers, as it is not large enough to furnish business for more than one company. The Legislature, however, has decided that no special privileges should be granted to Danvers, as it would form a dangerous precedent for other cities to act on.

APPLICATIONS OF POWER.

Berkeley, Va.—An electric railway company has been organized.

Nashville, Tenn.—Electricity is talked of for the East Nashville Street Railroad Company's line.

Middlesboro, Ky., has under consideration proposals to build an electric light plant and an electric road.

Charleston, W. Va.—The new electric road is to be built and operated by the Kanawha Electric Light Company.

Chattanooga, Tenn.—An electric railway franchise has been asked for by W. B. Mitchell, S. R. Read, W. H. Hart and others.

The Yankton, Dak., Street Railway Company, which has a charter for street car lines on all streets, will build its electric road this year.

Seattle, W. T.—The Woodland Park Electric Railway Company has been formed by G. C. Phinney, D. Jones and others, with a capital stock of $100,000.

The Electric Motor Renting Company, of Chicago, has been formed by D. Dichington, C. A. Robinson and M. D. Black, with a capital stock of $30,000.

Newport, R. I., proposes to have an electric road, but the improvement does not altogether commend itself to some of the fashionable summer residents.

San Francisco.—Mr. Jayne, the Sprague agent, has closed a contract for a road with four freight cars for the big Spreckels sugar refinery at San Francisco.

Excelsior Motors.—The Excelsior Company report among their recent sales of electric motors, six in Brooklyn, of 2 and 3 h. p.; five for Texas, of 1 h. p.; one of 10 h. p. for Tillman's toboggan slide, Coney Island; two for Harrisburgh, Pa.; and one of 5 h. p. for Boston.

Jamaica, L. I.—The electric railroad now running from Brooklyn to Jamaica has been purchased by a syndicate, headed by I. B. Newcombe, the banker, and is to be operated in connection with the Kings County Elevated Road. This plan will provide rapid transit from Fulton Ferry to Jamaica, and, it is thought, will build up the little places just outside of Brooklyn.

PERSONALS.

Mr. M. V. Ingram, of Kansas City, has the contract for putting in the electric light plant at Argentine, Kan.

M. Gaston Plante, the distinguished French inventor of the type of storage battery bearing his name, died at Paris on May 23.

Mr. Henry L. Storke, the treasurer of the National Telephone Exchange Association, is seriously ill at his home in Auburn, N. Y.

Mr. H. D. Bayne, an electrical engineer known to many in this country, has been engaged putting in a 100-light plant of the Ball system for Buffalo Bill's Wild West Show now in Paris.

Mr. Francis W. Parker, the patent attorney and expert, of Chicago, and counsellor of the Sperry Electric Light Company, will attend the Paris Exposition, and his address will be Grand Hotel, Paris, during the summer.

Mr. W. H. Meadowcroft leaves the Edison United Manufacturing Company to take a position with the Edison Lamp Company, at Harrison, N. J. The "small lamp" business will go back with him to the Lamp Company, and will in future be conducted entirely there.

Mr. Frank J. Sprague and family sail for Europe next week. Mr. Sprague will take in the Paris Exposition with observant eyes. His report for the government on the Crystal Palace Electrical Exhibition is well remembered as a careful and masterly performance, and the copies of it, now rare, are greatly prized by their possessors.

Mr. Leo Daft will read an important paper before the American Institute of Electrical Engineers, at the College of the City of New York, on June 18, at 8 P. M., on electricity on the elevated roads and the manner in which its use solves the rapid transit problem. The meeting is open to all electrical engineers and others interested in the subject.

Mr. J. H. Vail, the well-known and estimable general superintendent of the Edison Electric Light Company, has, it is understood, tendered his resignation. It is said that he would like to get a brief vacation after so much hard and successful work all over the country, but there is a pressing demand for his invaluable services in every direction.

MISCELLANEOUS NOTES.

New York Electrical Society.—A meeting of the society will be held on Wednesday, June 12, at the American Institute, Clinton Hall, at 8 P. M., when Mr. W. J. Jenks, of the Edison Standardizing Bureau, will read a paper on the Edison three-wire system, which will be popularly described for the first time.

Electrical Execution.—A special dispatch from Buffalo, N. Y., of June 5 says: "An appeal will be made by Charles S. Hatch, attorney for William Kemmler, now awaiting electrical execution at Auburn prison, from the decision of the Supreme Court, on the ground that the sentence imposed is cruel and unusual. First a habeas corpus proceeding will be instituted to learn the method and details of the proposed execution. Subsequently the case will be appealed, and electrical experts will be summoned as witnesses. Mr. Hatch has associated W. Bourke Cockran, of New York, with him in the appeal."

Kemmler's Death by Electricity Postponed.—A special dispatch from Buffalo, of June 7, says: William Kemmler's execution by electricity was to-day postponed without date by the service on District Attorney Quinby of a notice of appeal. Lawyer Cockran of New York, will soon apply for a writ of habeas corpus on which to test the power of the State to hold Kemmler subject to suffering the electric death penalty. District Attorney Quinby says that the appeal will cost the county several thousand dollars, and will delay the execution for several months. Kemmler has no funds to pay the expenses of these proceedings, and people are curious to know who is going to pay the costs.

Seattle, W. T.—This new and flourishing city was almost wholly destroyed by fire on June 7. All the elecrical plants in the city were burned up. A special dispatch of June 7 from Montreal says: "The manager of the Canadian Pacific Telegraph Company at Seattle, W. T., telegraphs the manager of the company in this city that the entire city has been wiped out by the flames. He was barely able to get his instruments out of the office. Twenty minutes after vacating the old office, he opened for business outside the town. All messages and papers belonging to the old office were removed, but so hotly were the manager and his clerks pursued by the fire that they had to drop all but the instruments and run for it. No wagons could be had for love or money."

The "Eureka."—The pneumatic propulsion vessel "Eureka," owned and operated by Mr. John Leroy, of Brooklyn, was given a trial in the East River last week. The motive power is furnished by explosions through apertures, one in each quarter. The explosions are produced by air and petroleum, the ignition being effected by an electric spark. In going up the river the "Eureka" had a strong flood tide in her favor and appeared to be moving at the rate of from five to six knots an hour. When Mr. Leroy attempted to put the "Eureka" about and stem the tide, she came around so awkwardly that a helping line had to be thrown her from the accompanying tug. When the "Eureka" was fairly pointed she breasted the strong flood tide and made very good headway.

BUSINESS NOTICES.

The Ætna Machine Company, of Warren, O., have received an order from the Youngstown Bridge Company, Youngstown, O., for an engine to drive the machinery in the bridge works now building at Hazelton.

Chas. A. Schieren & Co., New York, are the patentees and sole manufacturers of the perforated electric leather belting. The perforations obviate air cushions; hence belts run slack with less strain on bearings, and without slip.

J. Elliott Shaw & Co., of 55 and 57 North Seventh st., Phila., have issued a neat catalogue and price list this month. They make lla the well-known "Shaw & Geary" specialties in their own factory, and guarantee them in every respect. They handle also a variety of other apparatus, which is duly described and illustrated.

Shaffer & Budenberg, of 40 John street, this city, find that with the better methods obtaining in central station practice, there is a new demand for their speed indicators or tachometers. In fact, no station is complete without such apparatus, which pays for itself in a very short time and is soon found to be indispensable by every superintendent.

Patterson, Jordan & Gottfried, 146-150 Centre street, carry a complete stock of brass and iron machine and wood screws cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rod sheet German silver, sheet brass, machinery, tools, hardware, etc, Electric motor supplies.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JUNE 4, 1889.

404,426. Unison Device; George F. Oehmen, of New York, N. Y. Application filed June 16, 1888. The combination of a step-by-step mechanism, a unison therefor holding said step-by step mechanism from operating under normal currents when held at unison, a battery, a line wire, and an included electro-magnet controlling said step-by-step mechanism, and a transmitter located in the line and connected to battery at more than two points and itself governing both the full and partial amount of battery thrown on the line.

404,438. Non-Interfering Fire Alarm Signal Box; John J. Ruddick, of Richmond, Ind., Assignor by mesne assignments to the Interstate Fire Alarm Company, of Omaha, Neb. Application filed Dec. 14, 1888. The distinguishing feature of this invention is that means are furnished whereby, when two boxes have been operated simultaneously, the signaling apparatus of both will be set in rotation, but only one will be electrically operative, that one being automatically stopped when it has sent in its signal and the other continuing its rotation until its signal has also been transmitted.

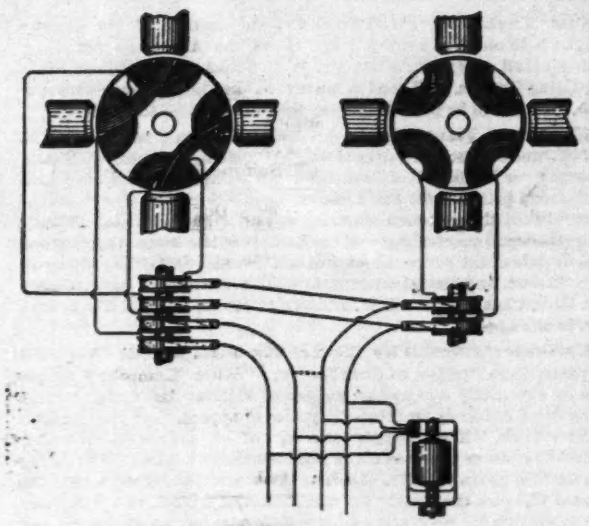
404,441. Motive Mechanism for Railway Cars; Henry F. Shaw, of Boston, and George F. Shaw, of Dedham, Mass. Application filed Jan 26, 1889. The invention consists in a device in which an external gear and an internal gear are in engagement with each other, the gears being so mounted that one will rotate about its axis, while the other will not revolve on its own axis, but be carried in such a manner that its axis will move around the axis of the other gear.

404,457. Railway Signal; A. Jackson Wisner, of Philadelphia, Pa. Application filed Jan. 24, 1888. Continuous successive blocks of signals are operated as the rear signals cease to operate.

404,463. Filament for Incandescent Electric Lamps; Turner D. Bottom, of New York, N. Y. Application filed Sept. 28, 1888. The process of manufacturing filaments, consisting in incorporating a suitable filamentary body with oxide of molybdenum and then heating the same in the vapor of a sulphur compound, whereby the oxide is transformed into sulphide.

404,465, Electric Motor; Charles S. Bradley, of Yonkers, N. Y. Application filed Oct. 5, 1888. An electric motor comprising a field magnet adapted to be energized by the eddying currents due to the rotation of the poles of the armature, in combination with an armature having magnetic poles rotating independently of its motion.

404,466. Alternating Current Electric Motor; Charles S. Bradley, of Yonkers, N. Y. Application filed Feb. 18, 1889 In an alternating current electric motor having an induced field-circuit, the combination therewith of an automatic switch



404,567. SYSTEM OF GENERATORS FOR ALTERNATE CURRENTS.

adapted to close said field circuit on arrival of the armature at its normal speed. See illustration.

404,469. Electric Railway; William Cannell, of Cleveland, O. Application filed July 2, 1888. In an electric railway, the combination of a sleeper provided with a longitudinal groove, a conduit carrying a conductor secured partially within said groove, said conduit open on its lower face only, and a rail projecting over and protecting the conduit.

404,470. Voltmeter; Leo Daft, of Plainfield, N. J. Application filed July 10, 1888. A voltmeter consisting of a coil, the core of which is provided with a slotted extension supporting a cam-shaped armature within the slot, and having a pointer connected to the armature, whereby the cam-shaped armature is normally maintained in a uniform field of force, and is operated by repulsion in accordance with the variations of the current passing through the coil.

404,471. Telephone Transmitter; Edwin S. Drake, of Cambridge, Mass. Application filed May 24, 1888. A telephone transmitter, embodying the combination of a diaphragm, with a supporting case or front provided with separate but connecting inlet and outlet air conduits or passages, so arranged relatively to the diaphragm that the vocalized impulses directed to the diaphragm through the inlet passages will be reflected directly therefrom through the outlet passage.

404,484. Dynamo Electric Machine; William Hochhausen, of Brooklyn, N. Y. Application filed Feb. 1, 1889. In a dynamo electric machine or motor, a field of force magnet, consisting of two electro magnets whose cores are curved in the arc of a circle, which, prolonged, would pass through the centre of the armature, and which magnets have their core ends of the same name magnetically distinct, so far as concerns union, by a mass of magnetic material, but held in proper proximity and properly formed to constitute together a field of force pole piece.

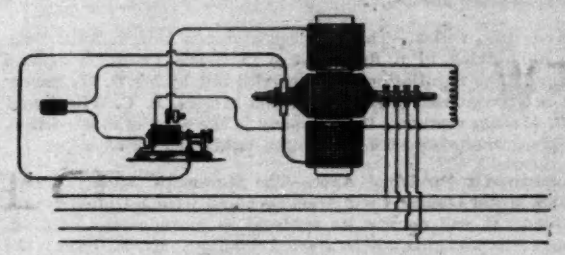
404,507. Telegraph Apparatus; Ebenezer B. Shater, of New York, N. Y. Application filed Feb. 18, 1889. The invention is an improvement in telegraph apparatus, whereby it is designed to provide a simpler system for being operated by unskilled persons than such as now used.

(1) 404,518. Fire-Alarm Telegraph; (2) 404,519. Duplex Fire Telegraph; Sidney Arthur Chase, of Evart, Mich., Assignor of one-half to William R. Mapes, of same place. Applications filed (1) May 24, 1889. (2) Sept. 11, 1888. (1) In a fire-alarm system, a trembler bell having an electro-magnet included in the main line circuit, the armature of which carries a contact spring adapted to contact with a circuit-closer on its back contact, in combination with two circuit-closing springs connecting such back contact with the battery through a local circuit, said circuit closing springs, being provided with a plug for separating them electrically. (2) A signal transmitter for use in a duplex system of fire or analogous signals, consisting of three discs, two of which have a definite signal on the same side of their periphery, the third having constant metallic contact with an earth circuit, while the others are connected by individual contact springs, and normally open main line circuits running by diverse routes to a receiving station, said main lines including the receiving instruments.

404,533. Electric Motor and Regulator; Alfred Gartner, of Newark, New Jersey, Assignor by mesne assignments to the Continental Motor and Electrical Company, of same place. Application filed July 6, 1888. In an electric motor, the combination of a frame and series of magnets secured therein, a shaft and a series of magnets secured thereon, the said magnets of one series alternating with those of the other series, and all of said magnets each having two end plates, with a hub and wires between.

404,559. Track Moistening Apparatus for Electric Railways; Edward D. Priest, of Lynn, Mass. Application filed Feb. 16, 1889. In an electric railway in which the rails form part of the supply circuit, means for decreasing the resistance between the wheel or wheels and said tracks, comprising apparatus for supplying a moistening liquid to the track, or to the wheels and track.

404,566. Method of Distribution by Alternating Electric Currents; Oliver B. Shallenberger, of Rochester, Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed Aug. 25, 1888. The method of electrical distribution



404,466. ALTERNATING CURRENT ELECTRIC MOTOR.

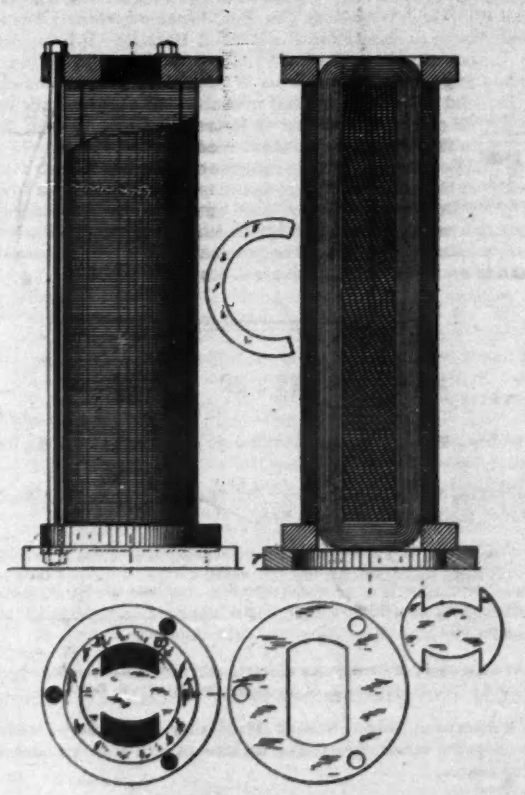
which consists in the generation of an alternating current by the superposition of two alternating currents differing in phase and the derivation of currents therefrom some dependent upon the component currents and some upon the resultant currents formed by their combined actions.

404,567. System of Generators for Alternating Electric Currents; Oliver B. Schallenberger, of Rochester, Assignor to the Westinghouse electric Company, of Pittsburgh, Pa. Application filed Sept. 8, 1888. In carrying out the invention there is applied to the armature of one of the generators supplemental coils, which are connected in parallel with the main generating coils of the other armature. The current delivered by these supplemental coils tends to hold the armature of the other generator in the same position with reference to its field magnets as is occupied by the supplemental coils and vice versa. See illustration.

404,600. Determining the Temper of Iron or Steel; Carl August Caspersson, of Forsbacka, Marzretchill, Sweden. Application filed Feb. 12, 1889. A method of determining the temper of iron or steel, consisting in conducting an electric current through a sample or test piece of the iron or steel, the temper of which is to be determined, melting it off and comparing the intensity of the current requisite with the strength of the current required to melt off pieces of normal steel of the same minimum cross-section as the sample and of known temper, either directly by placing the above mentioned normal pieces in the same electric circuit, or indirectly by the aid of an ampèremeter.

404,602. Regulator for Dynamo-Electric Machines; Ernest P. Clark, of New York, N. Y., Assignor to the Clark Electric Company, of same place. Application filed Oct. 8, 1888. The invention relates to the automatic regulation of dynamo-electric machines. It is designed for the regulation of a constant current shunt wound machine. It consists of a small electromotor having its field magnets in the main circuit of the dynamo and its armature in the shunt circuit, which also includes the field coils of the dynamo. The counter electromotive force of this motor is the regulating power.

404,630. Induction Coil; John F. Kelly, of Hoboken, N. J., Assignor to the United States Electric Lighting Company, of same place. Application filed Oct. 30. 1886. An induction coil or transformer of alternating electric currents, consisting of a sectional iron core provided with grooves or channels, primary and secondary conductors, and an outer sheathing, the primary and secondary conductors being wound in the same grooves or channels, and being equally close to both the core and the sheathing. See illustration.



404,630. INDUCTION COIL.

404,651. Safety Attachment for Electric Motors; William S. Paca, of Baltimore, Md., Assignor of one-half to John P. Paca, of same place. Application filed Jan. 11, 1889. In combination with an electric motor, a short circuit around the motor and a pivoted arm sustained by the driving belt carrying a short circuit closer. See illustration.

404,661. Electric Motor; Henry B. Slater, of Detroit, Mich., Assignor to the Belding Motor and Manufacturing Company, of Chicago, Ill. Application filed December 15, 1887. In a dynamo-electric machine or motor, the combination with its commutator and brushes, of a brush holder provided with a series of hollow cavities, and a spring pawl or detent for giving to it a substantially rigid engagement at each of a series of adjustments, said spring detent and cavities being housed between the face of the brush holder and the adjacent supporting part of the frame.

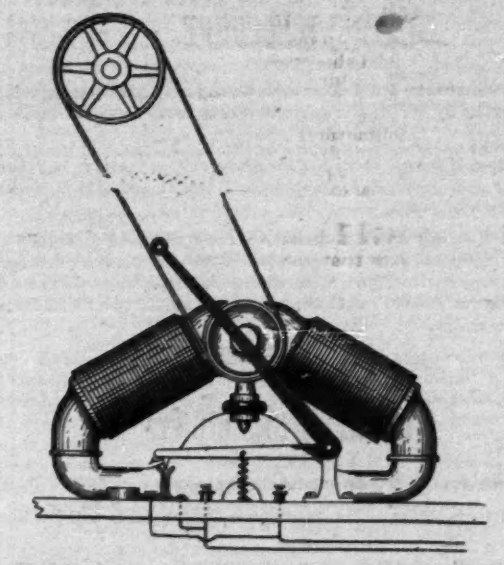
404,667. Fireman's Electric Wire Cutter; Daniel A. Woodhouse, of Elizabeth, N. J., and Thomas V. Forster, of Brooklyn, N. Y. Application filed March 2, 1889. For description see THE ELECTRICAL WORLD, June 8, 1889.

404,680. Telephone Support; Charles W. Brown, of Montreal, Quebec, Can., Assignor to the Bell Telephone Company, of same place. Application filed March 31, 1888. Renewed Feb. 25, 1889. Patented in Canada, May 20, 1888. A telephone transmitter carried in a cup formed on a casting to which the mouth piece is attached, said casting having an extension terminating in a sleeve sliding on a vertical rod secured to a box containing an induction coil, or to any other suitable base, and means for securing the sleeve at the desired height.

404,687. Electric Railroad; Leo Daft, of Plainfield, N. J. Application filed June 30, 1888. In an electric railway, the combination, with an insulated plate, of vise-grips secured thereto and supporting the trolley conductors, posts arranged along each side of the track supporting the main current conductors, wire connectors between the posts and plate serving to support the plate and conduct the main current to the trolley conductors, and electric connections between the connectors and the main current conductors.

(1) 404,698. Portable Electric Lantern; (2) 404,699. Galvanic Battery; William Frishmuth, of Philadelphia, Pa. Applications filed Nov. 8, 1888. (1) The combination, in a galvanic cell, of a containing vessel, a rock shaft extending across the same, an electrode rigidly secured at its upper portion to said shaft, and an electrode loosely secured to the shaft, the shaft freely rotating in the last-mentioned electrode and carrying said first-mentioned electrode with it during its movement of rotation. (2) As a new article of manufacture, a non-conducting porous insoluble porous refractory solid in dry comminuted form, containing in its pores a substance or substances capable of acting as a depolarizer in a galvanic cell.

(1) 404,712. Detachable Brush Holder for Dynamos, (2) 404,713. Armature Core for Dynamos; (3) 404,714 Regulator for Dynamo-Electric Machines and Motors; (4) 404,714. Brush Spring for Dynamos; Jesse F. Kester, of Terre Haute, Ind. Assignor of three-fourths to Joseph H. Briggs, of same place. Applications filed Oct. 29, 1888. (1) In a dynamo or motor the combination, with a journal box for the armature shaft, of a collar loosely and adjustably mounted on the same, a brush holder support detachably secured to the collar, and a handle provided with a screw extending through the support and collar. (2) As a new article of manufacture, an armature consisting of a hollow core open at the ends and upon the outer periphery of which the coils are adapted to be placed, the ends of said core being notched, and end pieces consisting of central aligned hubs to fit upon the armature shaft, and radial arms to fit in said notches and hold the armature to the shaft. (3) A regulator for a dynamo or motor, comprising a regulating circuit, a speed governor mounted upon a rotating part of the machine and a circuit controller included in the circuit and comprising a stationary contact point and a bell-crank lever pivoted to the rotating part of the machine, one arm of which is connected with the governor and the other arm forming the shifting contact movable to or from the stationary point. (4) The object of the invention is to provide a cheap, simple and durable brush holder wherein the separate holders of each brush are connected together



404,651. SAFETY ATTACHMENT FOR ELECTRIC MOTORS.

by a brush spring, causing the commutator brushes to bear upon the commutator with precisely the same tension and thereby wear the commutator uniformly round and even.

404,783. Regulator for Electric Motors; Alfred Gartner, of Newark, N. J. Application filed July 7, 1888. In an electric speed regulator, the combination of a rotary shaft, an insulated collar, conductors, a hoop fixed to said insulated collar and moving longitudinally on said shaft under the influence of centrifugal force, and a contact bearing adapted to engage the hoop, and complete an electrical circuit.

404,801. Electric Meter for Alternating Currents; Marmaduke M. M. Slattery, of Fort Wayne, Ind., Assignor to the Fort Wayne Electric Light Company, of same place. Application filed March 14, 1889. In an alternating current meter having a fixed primary coil conveying the current to be measured and a secondary closed coil in inductive relation therewith, a moving part consisting of a copper cylinder carrying soft iron discs and revolving in inductive relation to both of said coils.

404,813. Electric Cable Terminal; Robert H. Widdicombe, of Chicago, Ill., Assignor to the Western Electric Company of same place. Application filed April 1, 1889. The object of the invention is to provide a terminal connection for such cables of such construction that moisture may be kept away from the paraffine or other filling at the end of the cable, while the conductor is covered, so as to avoid the liability of accident in handling, and at the same time ready means afforded for connecting a kerite, gutta-percha or other insulated conductor therewith.

PATENTS EXPIRED JUNE 11, 1889.

127,809. Improvements in Pole Changers for Electrical Apparatus; John E. Smith, of New York. A pole changer, composed of a toothed wheel, springs and adjustable screws or points of electrical contact.

127,810. Improvements in Electro-magnetic Motor; John Taggart, of Boston, Mass. A rotary shaft and ratchet wheel arranged and combined with a pawl carrier and its pawls, and with helices, slide rods, armatures and a circuit breaker.

127,931. Improvement in Electric Annunciators; Jacob B. Shannon, of Philadelphia, Pa. An electric annunciator in which the covers for the numbers of characters designating the several rooms are caused to turn in one direction only, making a partial revolution when released in order to expose the numbers, and continuing the motion in the same direction so as to complete the revolution, when turned to cover the said numbers.

127,844. Improvement in District and Fire-Alarm Telegraphs; Edward A. Calahan, of Brooklyn, N. Y. The object of this invention is to connect any desired number of houses or other buildings with a central office in such a manner that communication can be had with that central office without disturbing the telegraphic instruments at the other buildings in the same line, thereby enabling any person to call for assistance from the main or central office in case of emergency.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.